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Approaches to assessing the effectiveness of decision analyses in strategy development contexts have yet to be widely covered in the academic literature. In particular, there are two major gaps: first, a lack of conceptual links between socio-technical decision analysis and strategy development processes, and, second, a limited number of approaches that assess empirically the process effectiveness of decision analyses. This PhD research contributes to filling these gaps.

The first part of this study analyses the contribution of socio-technical decision analysis to the effective development of strategies. I introduce a simplified taxonomy of strategy development that classifies socio-technical decision analysis as contributing both to enhanced information exchange ('socio' side) and improved information processing (technical side).

The second part of the study assesses the effect of socio-technical decision analysis. I develop two measures to test the process effectiveness as well as the group alignment effects of the approach. An application to six case studies shows that socio-technical decision analysis is perceived as consistently more effective than existing decision processes on eight 'socio', technical and result-oriented dimensions. In addition, it has helped to create group alignment. The study also indicates that a group of relatively inexperienced decision analysts can apply socio-technical decision analysis successfully. The empirical studies, however, revealed several weaknesses in the approach, in particular on the information exchange side.

The third part of the study addresses these weaknesses by introducing 'Strategy Conferencing'. The approach aims to enhance the effectiveness of socio-technical decision analysis in strategy development contexts by adding outside expertise to the process-based socio-technical decision analysis.

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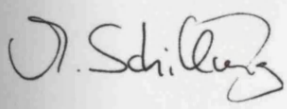

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The Contribution of Socio-technical Decision Analysis to Strategy Development Processes – An Effectiveness Study

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Martin Schilling

London School of Economics and Political Science

Management Department

Operational Research Group

2007

A thesis presented for the degree of Ph.D. at the

London School of Economics and Political Science /

University of London

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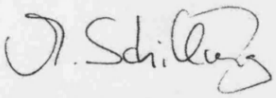
DECLARATION

This thesis is entirely my own work. It has not been submitted in any previous application for a degree. All quotations in the thesis are distinguished by quotation marks, and the sources of information specifically acknowledged.



Martin Schilling

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Whilst this PhD thesis is entirely my own work, many contributed to shape its final result. I would like to acknowledge the valuable support of several academics and practitioners as well as the MARA organisational team, who contributed to create the research context for this work.

Without the valuable support of Professor Larry Phillips, this thesis could never have been written. I would like to thank him for all our inspiring and enjoyable conversations while I was writing this thesis, as well as for his early and unconditional support for the applied research projects MARA 2005 and MARA 2006. His focus on outreach, transferring useful theory into practice and vice versa, was and will be a major inspiration for me. In addition, I would like to acknowledge the helpful comments on methodologies, data analysis and theory development of several other academics, such as Dr Matthew Mulford (LSE), Professor Gwyn Bevan (LSE), Professor Robert Clemen (Duke University) and Dr Gilberto Montibeller (LSE).

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ABSTRACT

Approaches to assessing the effectiveness of decision analyses in strategy development contexts have yet to be widely covered in the academic literature. In particular, there are two major gaps: first, a lack of conceptual links between socio-technical decision analysis and strategy development processes, and, second, a limited number of approaches that assess empirically the process effectiveness of decision analyses. This PhD research contributes to filling these gaps.

The first part of this study analyses the contribution of socio-technical decision analysis to the effective development of strategies. I introduce a simplified taxonomy of strategy development that classifies socio-technical decision analysis as contributing both to enhanced information exchange ('socio' side) and improved information processing (technical side).

The second part of the study assesses the effect of socio-technical decision analysis. I develop two measures to test the process effectiveness as well as the group alignment effects of the approach. An application to six case studies shows that socio-technical decision analysis is perceived as consistently more effective than existing decision processes on eight 'socio', technical and result-oriented dimensions. In addition, it has helped to create group alignment. The study also indicates that a group of relatively inexperienced decision analysts can apply socio-technical decision analysis successfully. The empirical studies, however, revealed several weaknesses in the approach, in particular on the information exchange side.

The third part of the study addresses these weaknesses by introducing 'Strategy Conferencing'. The approach aims to enhance the effectiveness of socio-technical decision analysis in strategy development contexts by adding outside expertise to the process-based socio-technical decision analysis.

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Chapter 1 – Introduction

1. Introduction

It is not the method which aids effective decision making – it is the personality of the analyst which really matters.

Interview partner for this PhD thesis

Following my Master's degree in Decision Science at the London School of Economics, I was considering doing a PhD in Decision Science. A discussion with a German professor of Psychology on the applicability and usefulness of decision analysis finally convinced me to pursue the research presented in this PhD thesis. As indicated in the quote above, this professor held the view that the success of a decision analysis mostly rests on the charismatic abilities of the analyst and not on the method itself. This assertion was one of my initial inspirations for embarking on this PhD research.

In order to test whether – contrary to the view mentioned above – inexperienced decision analysts can apply socio-technical decision analysis (STDA) successfully in strategy development processes, several colleagues and I created the applied research project MARA 2006. Backed by the empirical data generated through this research, the fundamental objective of this thesis is to create some new theoretical insights and frameworks in order to advance conceptually socio-technical decision analysis. In the following sections, I briefly outline the position of this research, together with the research objectives and the specific contributions to the research questions posed by each chapter.

1.1. The Position of this PhD Research

As displayed in Figure 1.1, this PhD research is located at the intersection between the areas of decision analysis, strategic management and organisational development. In the area of decision analysis, a variety of approaches to help organisations make better decisions exist. These include, for example, probability modelling with Bayesian networks, scenario analyses, risk modelling with simulations, decision trees or influence diagrams (Clemen, 1996; Goodwin and Wright, 2004; von Winterfeldt and Edwards, 1986) and negotiation modelling (Schilling, Mulford et al., 2006; Raiffa, Richardson et al., 2002). Within the area of decision analysis, this PhD thesis focuses on socio-technical decision analysis, as developed at the London School of Economics. As outlined in Chapter 3, this approach combines group decision processes in the

framework of decision conferences with the modelling of multiple objectives (Phillips, 1984; Phillips, 1989; Phillips, 1989; Phillips, 2006; Phillips and Bana e Costa, 2007).

This work thereby focuses on applying STDA in strategic contexts. A particular emphasis lies on the potential contribution of STDA to strategy development processes. In order to develop a clear research focus, I limit the concept of 'strategy development' in this work to the generation of strategic insights through the (model-based) analysis of resource allocation decisions. STDA can serve – as argued in this thesis – as one way to improve the effectiveness of existing strategy development processes. This focus on effectiveness studies links to the third area relevant to this research – organisational development (OD). OD researchers and practitioners usually concentrate on planned organisational change related to improving organisational effectiveness (Fagenson-Eland, Ensher et al., 2004; Worley and Feyerherm, 2003).

Focus of This PhD Thesis: Effective Strategy Development Using STDA

Figure 1.1 – Localisation of this PhD Research at the Interface of Decision Analysis, Strategic Management and Organisational Development

1.2. The Research Objectives

The three interfaces, depicted in Figure 1.1, lead to the fundamental objective of this research: to analyse and improve socio-technical decision analysis in strategy development contexts. This PhD thesis thereby aims to make the following three contributions to the existing body of knowledge:

First, this research starts with the question of whether STDA can be linked conceptually to strategy development processes. A variety of very different and yet-to-be-

consolidated perspectives on strategy development exist in the field of strategic management (Mintzberg, Ahlstrand et al., 1998; Mintzberg, Ahlstrand et al., 2005). Taking a descriptive stand, this work identifies the specific contributions of STDA to effective strategy development processes. In order to do this, I introduce a simplified taxonomy of strategy development modes and link each of these modes to STDA. Taking a prescriptive view, subsequently, this research introduces the concept of 'Strategy Conferencing' in order to increase the effectiveness of STDA in strategy development contexts.

Second, this work aims to develop an approach to empirically evaluate the effectiveness of STDA. Researchers have argued that STDA is perceived as more effective than ordinary meetings (Chun, 1992) and leads to better alignment of groups of decision makers to a joint way forward (Phillips, 2006; Phillips and Bana e Costa, 2007). For both claims, however, a comprehensive empirical basis has yet to be established. The study of Chun (1992), for example, did not include a comparison between STDA, existing decision processes and optimal states of decision processes. Using a socio-technical effectiveness framework, this PhD research aims to address this shortcoming by developing a new way of measuring perceived decision process effectiveness. In a second empirical study, this work measures the group alignment effects of STDA, as described by Phillips (2006). To my knowledge, there has not yet been an attempt to empirically analyse STDA induced alignment. This study therefore contributes to close this gap.

Finally, as a 'meta topic', this work aims to test the assertion that the charisma and expertise of the analysts is a prerequisite for the successful application of socio-technical decision analysis. The applied research project MARA 2006 served as a research framework in which groups of inexperienced analysts – mostly students and young professionals – applied socio-technical decision analysis, as developed at the London School of Economics. MARA 2006 consisted of six comparable case studies, which provided a suitable setting in which to analyse whether inexperienced analysts can effectively apply STDA.

1.3. Outline of the Thesis

Figure 1.2 displays the details of the contributions and contents of each chapter, as well as the macro structure of this thesis. Whilst Chapter 2 and Chapter 3 serve to lay

the conceptual groundwork in the area of strategy development processes and STDA, Chapters 4 to 6 constitute the empirical part of this research. The analysis of the effectiveness, strengths and weaknesses of STDA in these chapters serves as a basis for developing the concept of 'Strategy Conferencing' in order to enhance the effectiveness of STDA in strategy development contexts (Chapter 7).

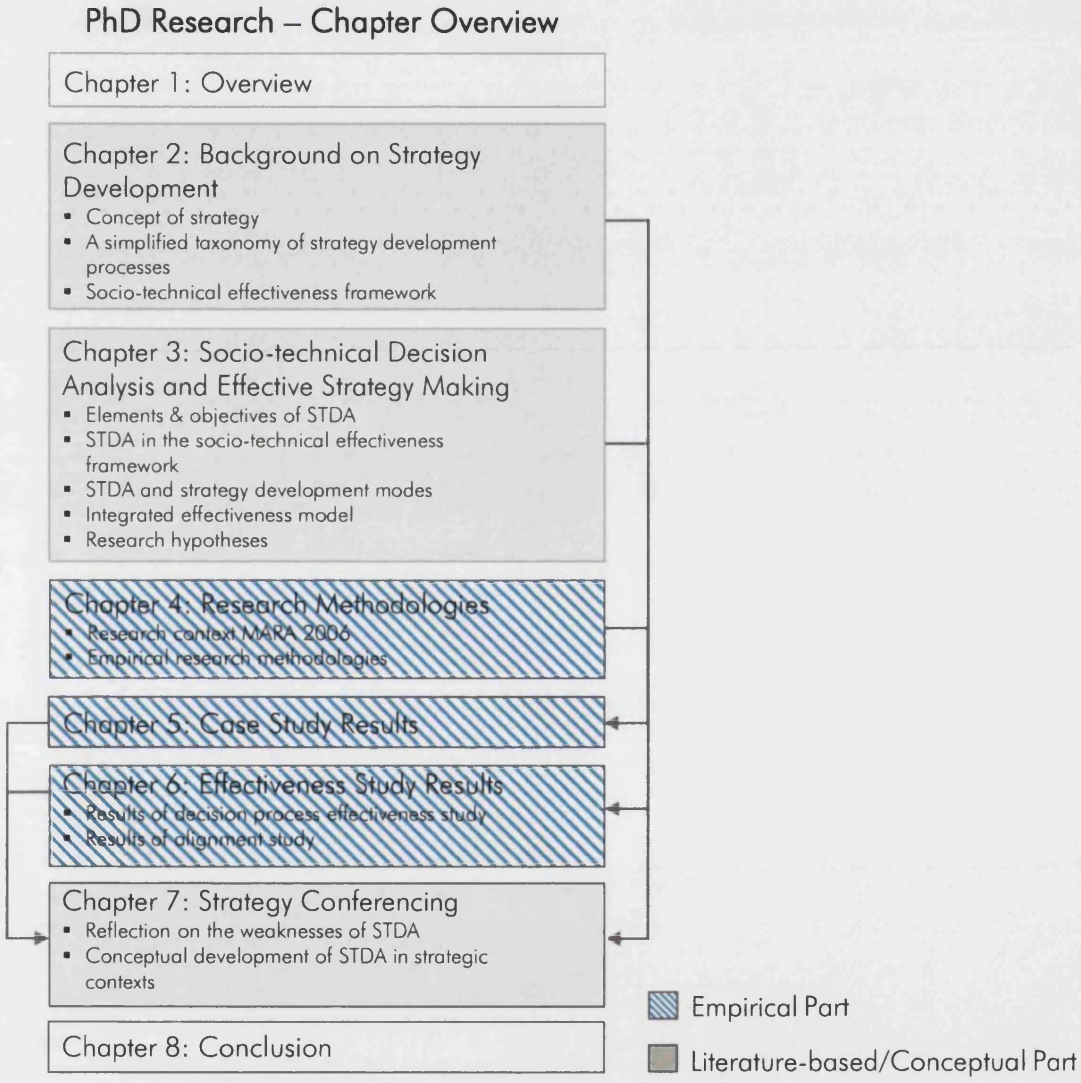

Figure 1.2 – PhD Research Overview

Following the introduction, **Chapter 2** gives a brief overview of the historical and recently developed concepts of strategy. The focus of this chapter is in particular on different strategy development processes in organisations. As research in this area continues to be rather limited, I develop a simplified taxonomy of strategy development

processes. A new socio-technical effectiveness framework serves to evaluate these five strategy development modes.

Chapter 3 focuses on the development of a simplified taxonomy of strategy development modes to classify STDA. This part of the research introduces the characteristics of STDA in relation to an information exchange dimension ('socio') and an information process dimension ('technical' side). This chapter also draws a link to existing effectiveness models and studies and offers an integrative model for effective decision making with STDA in strategy development contexts. Based on the conceptual groundwork of this model, I subsequently introduce the research hypotheses of this work.

Chapter 4 describes the research methodologies of this research. The chapter serves to introduce a new instrument – based on expert interviews – to evaluate decision effectiveness in strategy development contexts. In addition, it outlines the details of the MARA research framework, as well as the five research elements of this thesis. These include: ex-ante and ex-post interviews to generate and test the decision effectiveness dimensions, the survey-based effectiveness study, the alignment study and the six case studies, created within the framework of MARA 2006.

Chapter 5 outlines the details of the six MARA 2006 case studies. The cases include the development of an HR strategy in the context of Demographic Change, a recruiting channels optimisation, a prioritisation of investments in railway stations, an appraisal of research directions, a portfolio-based analysis of research strategies, as well as a prioritisation of infrastructure funding proposals. This chapter presents the context of each case, the models developed and the results.

Chapter 6 outlines the empirical study results carried out within the framework of the six MARA case studies. I describe and analyse the results of the decision process effectiveness study, which aimed to compare how the decision makers perceived the effectiveness of STDA with existing strategy development modes in the partner organisations. In addition, this chapter serves to outline the results of an alignment study, designed to test the degree to which STDA creates the alignment of preferences of groups for options under consideration.

One result of these analyses was the lack of data quality, external expertise and 'de-biasing' mechanisms of groupthink tendencies in the STDA process. Addressing these shortcomings, I outline in **Chapter 7** a new approach to integrate the problem-specific expertise of decision makers, the domain-specific expertise of external

consultants and the methodological expertise of decision analysts ('Strategy Conferencing'). The new approach aims to take up the call from practitioners to include more outside expertise in the process and the call from strategy researchers to put greater emphasis on the communication-oriented 'socio' side in strategy development.

Chapter 8 concludes this PhD research by outlining possibilities for further research, in particular in the area of effective group decision processes and consequence-related simulation studies. In addition, I refer back to the meta topic of this PhD research – whether relatively inexperienced junior analysts can apply STDA successfully.

Chapter 2 – Background on Strategy

2. Background on Strategy

"Cheshire Cat," she began... "Would you tell me, please, which way I ought to go from here? That depends a good deal on where you want to get to," said the Cat. "I don't much care where –" said Alice. "Then it doesn't matter which way you walk," said the Cat. "– so long as I get somewhere," Alice added as an explanation. "Oh, you're sure to do that," said the Cat, "if you only walk long enough."

Lewis Carroll, Alice's Adventures in Wonderland

Strategy – as indicated by the dialogue above – is often a search for direction. The process of this search in organisations constitutes the core of this chapter. Researchers and practitioners, striving to conceptualise 'strategy' and the corresponding processes, have been discussing the topic for centuries. Yet the concept remains a disputed, multi-faceted topic. The objective of this chapter is to shed light on some of these discussions and to lay the conceptual groundwork for the part of the PhD research at the interface between decision analysis and strategic management.

The chapter starts with a brief introduction to the concept of 'strategy' as well as to the area of strategic management. The second part focuses on strategy development processes. Based on the existing literature in this area, I develop a simplified taxonomy to classify strategy development modes. Subsequently, a new socio-technical effectiveness framework serves to classify these modes based on an information processing and an information exchange dimension. In particular, the simplified taxonomy of strategy development modes and the socio-technical effectiveness framework serve, in later chapters, to develop a link between strategy development and socio-technical decision analysis.

2.1. 'Strategy': An Introduction

The number of interpretations of 'strategy' has been growing exponentially over the last few decades. The suggested concepts, however, remain at times ambiguous for practitioners and academics alike. Practitioners often use the term as a synonym for 'expensive' or 'important' (Kay, 2005). Academic textbooks on strategic management, on the other hand, usually define strategy as *'top management's plans to attain outcomes consistent with the organisation's mission and goals'* (Wright, Pringle et al., 1992; p.3) or *'a set of managerial decisions and actions that determines the long-run performance of a corporation.'* (Wheelen and Hunger, 2006; p.6).

This thesis will not offer such easy interpretations. Following recent scientific (Pettigrew, Thomas et al., 2002; Mintzberg, Ahlstrand et al., 1998) and non-scientific (Mintzberg, Ahlstrand et al., 2005) integration attempts, this research will shed light on the concept of strategy from a decision analytic perspective. Besides the contribution to conceptually linking strategy making and socio-technical decision analysis in Chapter 3, this introduction serves to clarify the term 'strategic decision making' as used in this thesis.

Wheelen and Hunger (2006), for example, suggest that a decision is strategic, when it is rare, commits substantial resources ('consequential') and sets precedents for smaller decisions ('directive'). Besides the resource intensity and the long-term focus, Pearce and Robinson (2003) add as criteria the involvement of top management, as well as multi-functional or multi-business consequences. As a substantial amount of decision analyses is conducted without constant top level involvement and as these classifications are not particularly helpful for strategic decisions in the public sector, Phillips (2006) defines strategic decisions as primarily concerned with *what* an organisation can do, and *why*, to achieve its objectives. Operational decisions, on the other hand, relate to *how* the objectives should be achieved and *by when*.

My own classification includes a continuum of several dimensions. As outlined in Figure 2.1, a strategic decision can, first, be characterised by a high degree of 'context complexity'. A high number of relevant decision variables have to be taken into account, many of which are difficult to identify and incorporate a high rate of change (Jacques, 1998). Content complexity also includes a high degree of 'fuzziness' when defining the frame for the strategic decision problem at hand. Second, strategic topics tend to be clouded by uncertainty. Risks connected to the consequences of actions are of particular relevance in strategic contexts. A strategic issue, third, usually affects a variety of internal and/or external stakeholders, which can influence or are affected by the decision ('stakeholder complexity'). Fourth, strategic decisions usually have a high financial impact or substantially influence the overall goals of the stakeholders. These high impact decisions usually lead to a commitment of resources which is irreversible or only reversible at high costs. Finally, the time span within which the consequence of the strategic decision occurs, is usually long.

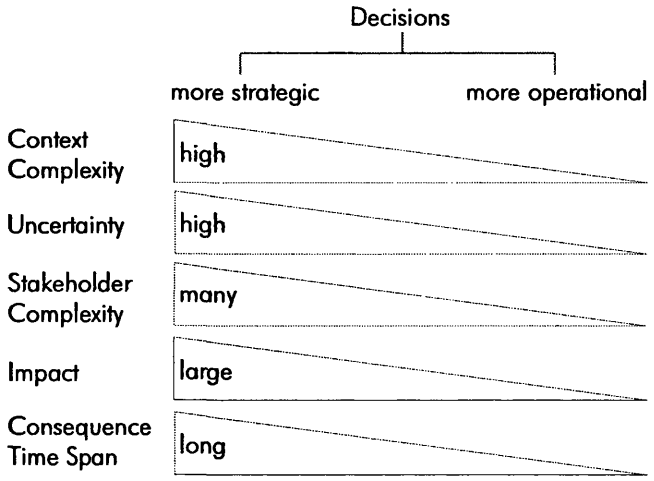

Figure 2.1 – Classification of Strategic vs. Operational Decisions

A decision analysis on the choice of a tritium supply technology for nuclear weapons (von Winterfeldt, 2007) serves to illustrate this classification. The tritium supply decision, first, included a high context complexity – 54 options had to be evaluated on 23 objectives. Second, the uncertainty connected to the analysis of the consequences of these options was considerable – production cycles of the technologies, for example, had to be simulated over 40 years. Third, a variety of stakeholders was involved: the US Department of Energy, the US Department of Defence, the US Congress, public interest groups and private suppliers of tritium facilities. Fourth, the impact of the decision was high as the stakeholders saw the lack of tritium supplies as a threat to national security and the decision involved the investment of billions of dollars. Finally, the time span when analysing the consequences of, for example, the production and disposal of radioactive waste, was of several hundred years. Strategic issues with similar characteristics also occur in the private sector. They include, for example, M&A target selection, strategic investment prioritisation and R&D portfolio optimisation.

Due to the time intensity of decision analyses, successful applications usually focus on these more strategic decisions in the private and public sector with high organisational and/or analytical complexity, as described, for example, by Matheson (2005). The projects outlined in Chapter 5 are also more focused on the strategic rather than the operational decisions, according to the definition displayed in Figure 2.1.

After this conceptual classification of strategy, the following section outlines a brief historical perspective on the development of the area of strategic management.

2.2. Development of the Field of Strategic Management

The area of strategic management can be traced back historically to ancient military writers (Bracker, 1980). The following sections outline these early historical roots as well as the modern development of the area.

Historical Roots

The Chinese general, Sun Tzu (2002), was one of the first to extensively discuss the concept of strategy. Aroung 300 B.C. he recommended the development of military strategies based on environmental conditions: *'..the method of employing the military: when ten to one, surround them. When five to one, attack them. When two to one, do battle with them. When matched, then divide them... When inadequate, then avoid them.'* (Sun Tzu, 2002, p.10/11). Von Clausewitz (2005), on the other hand, stressed the influence of chance and probability on success on the battlefield by analysing 'frictions'. According to von Clausewitz, we should relate strategy making to flexible principles in order to be able to react quickly to sudden changes in the environment. Modern authors later referred to this flexible concept of strategy development as 'evolutionary', 'emergent' or 'generative' (Burgelman, 1996; Hart, 1992; Grant, 2003).

The Greek philosopher, Socrates, was one of the first to transfer the concept of strategy from the military to the business context. He defined strategy as the use of one's resources to reach objectives, which can apply as much to a general on the battlefield as a businessman on the market (Bracker, 1980). Von Neumann and Morgenstern (1944), as two more modern writers, interpreted strategy as a complete plan for every move in a formalised game. The increased volatility of environments and the speed of technological developments following the Second World War, laid the groundwork for continued and intensified research into strategy (von Pierer and Mirow, 2004; Mirow, 2004). Taking the concept beyond the formalised perspective of von Neumann and Morgenstern, authors such as Selznick (1957), Chandler (1962) and Ansoff (1965) established the field of strategic management in the early 1960s. The different lines of development in this area are the focal point of the following section.

Development of Strategic Management – Overview

Strategic management has traditionally focused on business concepts that influence firms' performance (Hoskisson, Hitt et al., 1999). Whilst this has not changed over the last forty years, the focus of research and the methodologies of the field have. Hoskisson, Hitt et al. (1999) compared these shifts to the swing of a pendulum between analyses of firms' internal resources and external analyses of the specific industries in which they are competing. Whereas the first contributions to the field were primarily concerned with the analysis of internal competitive resources (Ansoff, 1965; Selznick, 1957), at the end of the 1970s and 1980s, economists shifted the focus of the field towards the external environment of the firm (Bowman, Singh et al., 2002). Michael Porter's (1980) industry analysis represents the most influential contribution to this change in focus. With the introduction of the resource-based view in the late 1980s and 1990s (Barney, 1991; Wernefelt, 1984), the pendulum swung back towards an analysis of firms' internal resources. Table 2.1 gives an overview of the different research focuses in the area of strategic management over the last four decades.

	Inside Focus: Early Contributions	Outside Focus: Economics-based Views	Inside Focus: Resource-based Views
Research Focus	Focus on firms' internal strengths and weaknesses	Focus on firms' external environment	Inside focus on tangible and intangible resources of the firm
Time	Late 1950s and 1960s	1970s and 1980s	1990s
Representatives (Selection)	Selznick (1957) Andrews (Learned, Christensen et al., 1965/1969) Chandler (1962) Ansoff (1965)	Schendel and Hofer (1979) Henderson (1979) Schoeffler, Buzzell et al. (1974) Porter (1980; 1985)	Wernefelt, (1984) Dierickx and Cool (1989) Barney (1991) Prahalad and Hamel (1990) Hamel and Prahalad (1994)
Research Methods	Case studies, little attempt to generalise findings	Econometric analysis, databases and surveys	Case-based and smaller sample methods, limited surveys of firms

Table 2.1 – Research Focuses in the Field of Strategic Management Over the last five Decades (from Hoskisson, Hitt et al., 1999; Pettigrew, Thomas et al., 2002; Bowman, Singh et al., 2002)

Inside Focus: Early Contributions

At the end of the 1950s and the early 1960s, authors such as Selznick (1957), Andrews (Learned, Christensen et al., 1965/1969), Chandler (1962) set up the field of strategic management. These 'field researchers' (Bowman, Singh et al., 2002) provided cases, histories and planning systems for strategy-related issues from a top-level management perspective. Mintzberg (1998) classified theses approaches to strategy

development as 'design school'. This school of thought placed special emphasis on the appraisal of external threats and opportunities, as well as internal strengths and weaknesses. Based on these analyses, the authors recommended a structured evaluation of different strategies to be able to finally choose the best one.

In contrast to this 'business policy' view of the Harvard Business School researchers, Ansoff (1965) outlined a more planning-oriented view of strategy development (Pettigrew, Thomas et al., 2002). This 'planning school' approach (Mintzberg, Ahlstrand et al., 1998) views the process of strategy development as a consciously controlled process of formal planning, supported by checklists and techniques. The steps usually included definitions of objectives, internal and external audits and an evaluation of strategic alternatives. Ackoff (1983) summarised the theory of this school of thought as 'predict and prepare'.

The principal goal of these early contributions was to impart knowledge to practitioners, rather than enhance scientific knowledge (Hoskisson, Hitt et al., 1999). The authors therefore limited their research methodologies to single or comparative in-depth case studies of firms or industries in order to identify 'best practices'.

Outside Focus: Industrial Organisation Economics

In contrast to the case-based methods, Schendel and Hofer (1979) introduced a more analytical and economics–based view on strategy making in the 1970's. Instead of identifying 'best practices', they emphasised the quantitative analysis of firms' strategic issues and the industrial environment, such as entry barriers, economies of scale and scope, investment choices and industry concentration (Bowman, Singh et al., 2002; Pettigrew, Thomas et al., 2002).

Michael Porter (1980), who introduced the concept of 'industry analysis', is one of the most prominent members of this line of research. The central paradigm of his concept is the dependence of a firm's profit on its position in the industry in which it is competing (Porter, 1981). The analysis of the structure of an industry is therefore the focal point of Porter's Five Forces Model (Porter, 1980, 1985, 1995). The five forces that influence a firm's profitability include: the threat of new entrants, the threat of substitute products, the bargaining power of suppliers, the bargaining power of customers and the intensity of rivalry among competing firms. Based on the analysis of

these forces, Porter (1985) advocates the selection of generic strategies such as cost leadership, differentiation or focus, according to a firm's position in a specific industry.

The development of market positioning tools such as the Growth/Share Matrix of The Boston Consulting Group, Shell's Directional Policy Matrix, the General Electric Matrix or the A.D. Little Matrix supported the breakthrough of positioning school approaches in the 1970s and 1980s (for reviews, see Dibb, Simkin et al., 2006; Wheelen and Hunger, 2006; Bowman, Singh et al., 2002 or Wind and Mahajan, 1981). Most of these approaches advocate to make strategy recommendations based on the competitiveness of the firm's products/services and the related market opportunities. Mintzberg et al. (1998) classified these market positioning tools under the umbrella, 'Positioning School' – the selection of a generic position in the market, based on analytical assessments.

Inside Focus: Resource-based Views

Whilst the 'Positioning School' analyses industry structures or external competitive dynamics, the resource-based view switched the focus to firms' resources as determinants of competitive advantages (Pettigrew, Thomas et al., 2002; Wernefelt, 1984). We can trace the origins of this approach to earlier works, such as Penrose's (1959) 'collection of productive resources' and Selznick's (1957) 'distinct competencies'. The resource-based view thereby analyses competitive advantage as a function of the tangible and intangible assets of firms (Hoskisson, Hitt et al., 1999). Barney (1991) classifies these assets as physical capital resources (plant, equipment or geographical location), human capital resources (such as training, experience, staff judgment) or organisational capital resources (such as reporting structure, controlling and co-ordination systems). Strategically important resources are thereby those that enable a firm to exploit opportunities or neutralise threats in the external environment. In addition, they should be rare and difficult for competitors to imitate and to substitute (Barney, 1991).

Closely related to the resource-based view is the concept of core competencies and the knowledge-based view. Prahalad and Hamel (1990) view core competencies as a major source of competitive advantage for a firm. They provide access to a variety of markets, contribute significantly to the perceived customer benefits of the end-product and are difficult to imitate (Hamel and Prahalad, 1994). Viewing the resource-based

approach from another angle, authors such as Kogut and Zander (1992) and Nonaka (1988) focused on the acquisition, maintenance and utilisation of the knowledge of a firm. According to this 'knowledge-based theory', a firm is not only a bundle of tangible resources, but consists of tacit knowledge and processes for knowledge creation (Conner and Prahalad, 1996).

Other Approaches

The early contributions to the field from the Harvard Business School, the Industrial Organisation Economics and the resource-based approaches, reviewed above, capture several of the most important developments in the field of strategic management over the last few decades. As the conceptual part of this PhD research concentrates on the interface between strategic management and decision analysis, this review does not deal with developments from the area of strategic management which are less relevant to this work. These include organisational economics approaches based on transaction costs (Williamson, 1985), agency theory (Eisenhardt, 1989; Fama, 1980), game theory applications to strategy (Dixit and Balebuff, 1991) as well as corporate performance optimisation tools, such as the balanced scorecard (for reviews, see Wheelen and Hunger, 2006; Pearce and Robinson, 2003) or other strategy-related concepts, such as the scenario analysis (Schoemaker, 1993).

Most of the approaches to strategy making reviewed above, view strategy development as a rational, intended and purposeful thought process (Pettigrew, Thomas et al., 2002). Henry Mintzberg brought a new perspective to the field. He interpreted strategy as a semi-conscious process, rather than rationally intended thinking (Mintzberg, Raisinghanim et al., 1976; Mintzerg, 1973). His recent work 'Strategy Safari' (Mintzberg, Ahlstrand et al., 1998) gives a comprehensive overview of several strategy development 'schools' with a focus on the process of strategy development. The next section follows this line of analysis, consisting of a review of the most important strategy development processes.

2.3. Strategy Development Processes

As this PhD research focuses on effective decision processes, in this section, I will identify several shortcomings of the existing strategy development concepts and suggest a simplified taxonomy of how strategies are developed in organisations.

Existing Strategy Development Classifications

The most prominent controversy relating to the nature of strategy making processes is led by those who view strategy as a planned and rational process and those who emphasise emergent and flexible learning approaches to strategy development (Brews and Hunt, 1999). Ansoff, as one of the representatives of the planning school, advocates formal planning both in stable and volatile market environments (Ansoff, 1991). Mintzberg (1994; 1994; 1991), promoting the 'Learning School' of strategy development, favours emergent strategy making, especially in uncertain market settings. Using field observations (e.g. Mintzberg, 1973) or exploratory factor analyses (e.g. Bailey, Johnson et al., 2000 or Hart and Banbury, 1994), researchers extended the dichotomy between rational vs. emergent strategy making in the last decade to an array of different strategy development classifications.

These classifications, however, are partially artificial. As outlined above, Mintzberg et al. (1998) divide 'rational' strategy development into three 'schools': The 'Design School' (strategy development as a planned perspective), the 'Planning School' (strategy making as a stepwise planned process) and the 'Positioning School' (strategy development as a selection of generic strategies based on industry environment). All three schools seem to overlap substantially. In addition, the integration of top-level command perspectives and visionary strategy making in an 'Entrepreneurial School' contradicts earlier empirical work where these dimensions appear separately (Bailey, Johnson et al., 2000; Hart and Banbury, 1994).

Some confusion also exists between a classification dimension for strategy development processes and strategy development modes themselves. Whilst modes or frameworks provide methods for developing strategies within organisations, we can use classification dimensions to analyse these modes. Rational or political strategy development are, for example, modes which can serve to evaluate dimensions, such as 'degree of formal information processing'.

Addressing these criticisms, the next section introduces a simplified taxonomy for strategy development modes, which I later use to classify socio-technical decision analysis.

A Simplified Taxonomy for Strategy Development Modes

Although researchers have been classifying strategy development modes since at least the early 1980's, a consensus on taxonomies does not yet exist. The ten strategy development schools of Mintzberg et al. (1998) represent a recent consolidation in this area, however, as mentioned above, the approach has some drawbacks and is too wide to be applicable to this research. A higher level of conceptualisation to resolve some overlaps and 'labelling confusion' is therefore necessary. Some of the most important studies in the area of strategy development processes over the last decades (Hutzschenreuter and Kleindienst, 2006; Collier, Fishwick et al., 2004; Bailey, Johnson et al., 2000; Mintzberg, Ahlstrand et al., 1998; Hart and Banbury, 1994; Hart, 1992; Nonaka, 1988; Ansoff, 1987; Mintzberg, 1987; Shrivastava and Grant, 1985; Mintzberg and Waters, 1985; Chaffee, 1985; Bourgeois and Brodwin, 1984) can be consolidated using the simplified taxonomy, as displayed in Table 2.2. The system categorises strategy development processes in rational, adaptive, command-based, visionary and political modes.

A Simplified Taxonomy of Strategy Development Modes

	Rational	Adaptive	Command-based	Visionary	Political
References	Strategy making as structured analysis based on thorough information processing	Strategy making as flexible learning process	Strategy making as controlled process from the top	Strategy making as perspective setting based on culturally shared core values	Strategy making as bargaining and persuasion based mutual adjustment
Bourgeois and Brodwin (1984)	Change, Collaborative	Crescive *(empowering subordinates)*	Commander	Cultural	
Chattee (1985)	Linear	Adaptive		Interpretative	
Mintzberg and Water (1985)	Planned	Process	Imposed Entre-preneurial	Ideological	Consensus
Shrivastava and Grant (1985)	Systematic bureaucracy	Adaptive planning	Managerial autocracy		Political expediency
Ansoff (1987)	Systematic	Reactive Ad-hoc			Organic *(internal bargaining)*
Mintzberg (1987)	Plan, Position	Pattern		Perspective	Ploy
Nonaka (1988)		Inductive	Deductive	Compressive *(middle managers transfer vision into action)*	
Hart (1992) Hart and Banbury (1994)	Rational	Generative	Command	Symbolic *(vision and mission related)*	Transactive *(internal processes and mutual adjustment)*
Mintzberg et al. (1998)	Design & Planning & Positioning School	Learning School	Entrepreneuri al School	Cultural School	Power School
Bailey et al. (2000)	Planning	Incremental	Command	Cultural	Political
Collier, Fishwick et al. (2004)	Rational/ Planning	Adaptable/ Incremental	Command	Culture	Internal politics
Hutzschenreuter and Kleindienst (2006)	Rational-mechanistic	Cognitive	Upper-echelon	Organic	Middle-management/ Micro perspective

Table 2.2 – Five Strategy Development Dimensions with Corresponding References (Cell entries are the original labels from the references mentioned)

Rational Strategy Development

In this mode, strategy making is characterised by a high level of formal information processing. Formal analyses, such as portfolio, scenario or SWOT analysis, as well as industry and competitive analyses, serve in this mode to aid strategy formulation (Porter, 1980; Bowman, Singh et al., 2002). This process is usually institutionalised through formal strategic planning systems (Hart, 1992). Top level managers usually monitor the activities of organisational members, who are held accountable for their performance, benchmarked against the plan (Hart, 1992).

There is a broad consensus on the existence of a rational approach to strategy development. Ansoff (1987) calls the approach 'systematic', Mintzberg and Waters (1985) 'planned', Hart (1992) 'rational', Bailey et al (2000) 'planned' and 'rational-mechanistic' (Hutzschenreuter and Kleindienst, 2006). Mintzberg (1998) classified, as reviewed above, rational approaches to strategy development as 'Planning School' (Ansoff, 1965), 'Design School' (Selznick, 1957, Learned, Christensen et al., 1965/1969; Chandler, 1962) and 'Positioning School' approaches, such as Michael Porter's (1980) industry analysis.

Researchers, however, have challenged the assumption of rational planning. Work on bounded rationality (Simon, 1957; March and Simon, 1958), heuristics and biases in human judgment (Tversky and Kahneman, 1974), and the impact of environmental influences on strategy development (Dutton, Fahey et al., 1983) in particular, prepared the ground for alternative views on strategy development.

Adaptive Strategy Development

Adaptive strategy development models regard strategy making as an incremental process (Wooldridge and Floyd, 1989), based on trial and error approaches. As a reaction to increased speed in technological developments and faster communication, shorter strategic planning cycles in organisations have emerged over the last few decades (Mirow, 2005). This development might be one core driver for the occurrence of more adaptive strategy development processes, which rests on at least two assumptions. First, decision makers have limited information processing capacities. These capacities can, for example, be 'boundedly rational' (Simon, 1957) or 'biased' (Tversky and Kahneman, 1974). Second, strategy development occurs in a piecemeal way through a sequence of comparisons between alternative courses of action and the

status quo – either as 'muddling through' without top-level guidance (Lindblom, 1959) or as logical 'incrementalism' with top level direction (Quinn, 1980). This incremental strategy development mode can manifest itself in iterative and small resource commitments (Burgelman, 1983; Burgelman, 1983). Strategy thereby emerges through initiatives by members of the organisation (Hart, 1992; Mintzberg, 1978; Cyert and March, 1963). This evolutionary approach to strategy development is especially favourable in complex and volatile environments, when self-organisation might lead to better results than top-down direction (Grant, 2003; Pascale, 1999; Burgelman, 1996).

Although a variety of researchers acknowledge the existence of an adaptive strategy development approach, a broad range of classifications exist: 'reactive' (Ansoff, 1987), 'unconnected' (Mintzberg and Waters, 1985), 'inductive' (Nonaka, 1988), 'generative' (Hart, 1992), 'learning' (Mintzberg, Ahlstrand et al., 1998), 'incremental' (Bailey, Johnson et al., 2000), 'adaptable' (Collier, Fishwick et al., 2004) and 'cognitive' (Hutzschenreuter and Kleindienst, 2006). The term, 'adaptive strategy development' in the simplified taxonomy, aims to integrate these classifications under the umbrella 'strategy making as a flexible, learning process'.

Command-based Strategy Development

When those at the top of an organisation formulate strategy and issue it to the rest of the organisation, strategy development is performed in a command mode. In this case a strong individual leader or small management team exercises control over the organisation (Hart, 1992). Strategy is, according to this perspective, connected to persons – semi-conscious and rooted in the experience and intuition of the leaders (Mintzberg, Ahlstrand et al., 1998). In this mode, top management can be viewed as commanders, and organisational members as 'soldiers', who execute the strategy formulated at the top (Mintzberg and Waters, 1985; Bourgeois and Brodwin, 1984). Strategy development in a strict top-down mode is in particular common in re-structuring situations, where high involvement of stakeholders would slow down necessary change significantly.

Whilst, as described above (Bourgeois and Brodwin, 1984; Hart, 1992; Bailey, Johnson et al., 2000, Hutzschenreuter and Kleindienst, 2006), some earlier researchers formulated a command mode of strategy development, Mintzberg (1998) mixed the command and visionary approach. In his 'Entrepreneurial School', the leader's

perspective combines both visionary and command-based aspects. This connection leads to several disadvantages when classifying strategy development, as outlined in section 2.3. The simplified taxonomy of strategy development modes therefore separates the command and the visionary strategy development process.

Visionary Strategy Development

In contrast to the command mode, in this mode, strategy development is not related to the experience and intuition of specific individuals, but to a shared belief and a resulting collective vision for all actors in an organisation (Mintzberg and Waters, 1985). This is connected to the long-term creation of an organisation's strategic intent (Hamel and Prahalad, 1989), which influences the culture of an organisation. In visionary strategy development, shared values help to guide the actions of all organisational members towards a common goal (Hart, 1992). The role of the top management is to motivate, inspire and coach (Weick, 1987; Hart, 1992).

Several authors describe visionary strategy development as 'cultural' (Bourgeois and Brodwin, 1984; Bailey, Johnson et al., 2000; Collier, Fishwick et al., 2004), 'perspective' (Mintzberg, 1987), 'symbolic' (Hart, 1992) or 'organic' (Hutzschenreuter and Kleindienst, 2006). Mintzberg's (1998) 'Cultural School', with strategy development as social interaction based on beliefs and understandings, is partly related to the visionary perspective. In the simplified taxonomy, presented in this thesis, visionary strategy development is summarised as 'culturally influenced perspective setting'. The vision may have emerged from a leader who has left the organisation (Mintzberg and Waters, 1982), but it is – in contrast to the command mode – no longer connected to specific individuals or organisational roles.

Political Strategy Development

The political strategy development mode views strategy development as bargaining and persuasion-based mutual adjustment. In this mode, stakeholders within organisations use negotiations and micro-politics for (usually non-transparent) information exchanges to create majorities for certain courses of actions. This view is thereby connected with a social constructivist view, where actors subjectively interpret reality, rather than accept it as objective (Watzlawick, 1984). Power, politics, bargaining

and confrontation are present in all organisations, however they are usually difficult to analyse (Mintzberg, Ahlstrand et al., 1998). In this strategy development mode, stakeholders resolve their differences via (non-transparent) negotiation, bargaining and compromise (Bailey, Johnson et al., 2000). These groups compete for resources and use the control of information for political advantage. Mintzberg (1989), for example, classified these political games as authority resistance, sponsorship games, alliance and power base building.

Researchers describe political strategy development as 'political expediency' (Shrivastava and Grant, 1985), 'ploy' (Mintzberg, 1987), 'internal politics' (Collier, Fishwick et al., 2004), 'political' (Bailey, Johnson et al., 2000) or based on a middle management and a micro perspective (Hutzschenreuter and Kleindienst, 2006). Hart's (1992) 'transactive' mode as strategy driven by internal processes and mutual adjustment, is also related to this concept.

Rational, adaptive, command-based, visionary and the political mode, are descriptions of possible strategy development processes. Whilst this kind of classification can be interesting for research purposes, the evaluation of the effectiveness of different strategy development processes is usually more relevant for practical purposes. The next section therefore focuses on the effectiveness of strategy development processes.

2.4. Dimensions of Effective Strategy Development

To further simplify the taxonomy, outlined above, I develop in the following section a two dimensional space to position the five reviewed strategy development modes. Two areas of the literature served to develop this framework: information processing research, which relates to a technical dimension, and literature on involvement in decision processes for the classification of strategy development processes on a socio dimension.

The Technical Dimension

One essential determinant of effective strategy development processes, is 'technical' information processing. Recent research established a positive association between the use of formal planning systems and firm performance (Hutzschenreuter and

Kleindienst, 2006; Andersen, 2000). This positive relation is, in particular, salient in unstable and turbulent market environments (Priem, Rasheed et al., 1995; Miller and Cardinal, 1994), it is moderated by planning duration (Brews and Hunt, 1999) and should not be focused solely on financial issues and budgets in order to be effective (Capon, Farley et al., 1994). Older studies view formal planning as most suitable in stable rather than unstable environments (Fredrickson and Iaquinto, 1989; Fredrickson, 1984).

The degree of formal information processing in strategy development can serve to classify strategy development modes. It is related to the degree of 'procedural rationality', defined as the collection of relevant information and thorough information analysis (Dean and Sharfman, 1993; Dean and Sharfmann, 1996). A higher procedural rationality thereby reflects a higher possibility of summarising and categorising information, as well as of considering further alternatives (Barra and Shardab, 1997). The technical dimension combines both the empirical ('data-driven') and rational ('clear thought') perspective of McCartt and Rohrbaugh (1989). The degree of formal analysis can thereby be categorised on a bi-polar continuum between formal/explicit and informal/implicit strategy development processes.

A highly formal and explicit strategy development approach includes the use of formal quantitative methods, institutionalised, for example, through formal strategic planning processes (Hart, 1992). On the other end of the continuum, strategy development occurs in an informal way. 'Informal' refers to all approaches where formal and structured information processing are less relevant. This includes, in particular, 'muddling through' approaches (Lindblom, 1959), 'logical incrementalism' (Quinn, 1980), flexible/emergent strategy development and power-based strategy development approaches, as described by Mintzberg et al. (1998).

Collier (2004) links rational decision making, outlined above, with involvement: 'Observers have also found that involving a broader range of organisational members makes strategic decision making more rational.' (p.69). It is, however, difficult to imagine that more involvement always leads to more rational strategy development. Participatory strategic decision making can lead to less radical decisions, which do not always have to be more rational, especially when companies have to re-structure. This is why involvement and the degree of participation is conceptualised in a separate second dimension.

The Social Dimension

Whilst the technical dimension relates to the question of how information is processed, the second dimension mirrors the question of who is involved in the process. More involvement in strategic decisions thereby usually lead to superior strategies (Wooldridge and Floyd, 1990) and improved implementation commitment (Korsgaard, Schweiger et al., 1995), which in turn can result in higher organisational performance (Floyd and Wooldridge, 1997). Collier et al. (2004) attribute enhanced searching for more alternatives and more diverse information as reasons for the increased performance through involvement. This accounts in particular for the involvement of middle management (Dutton, Ashford et al., 1997; Floyd and Wooldridge, 1997; Floyd and Wooldridge, 1992; Wooldridge and Floyd, 1990) and the enabling of dissent rather than consent (Dooley and Fryxell, 1999). In addition to diverse information input, participation can also lead to the better alignment of organisational members through shared strategic understanding (Wooldridge and Floyd, 1989) and a greater commitment to a joint way forward (Phillips and Bana e Costa, 2007). Due to a limited amount of empirical studies, the link between involvement and organisational performance is less solid than the relationship between formal planning and firm performance, as described above.

The empirical evidence is, however, sufficient to evaluate the effectiveness of strategic decision processes on the amount and diversity of information considered. The 'socio' dimension to measure the effectiveness of strategic decision making can therefore be located on a continuum between heterogeneous information input by multiple stakeholders or more homogeneous information input by autocratic and top level driven decision making.

Classification of Strategy Development Modes within the Socio-technical Effectiveness Framework

The degree of formal information processing (technical dimension) and the diversity of information input ('socio' dimension) now serve to position the different strategy development modes within the socio-technical effectiveness framework. As the framework's character is of a conceptual rather than empirical nature, the positions of

the different strategy development modes in the graph below have to be interpreted as relative to each other.

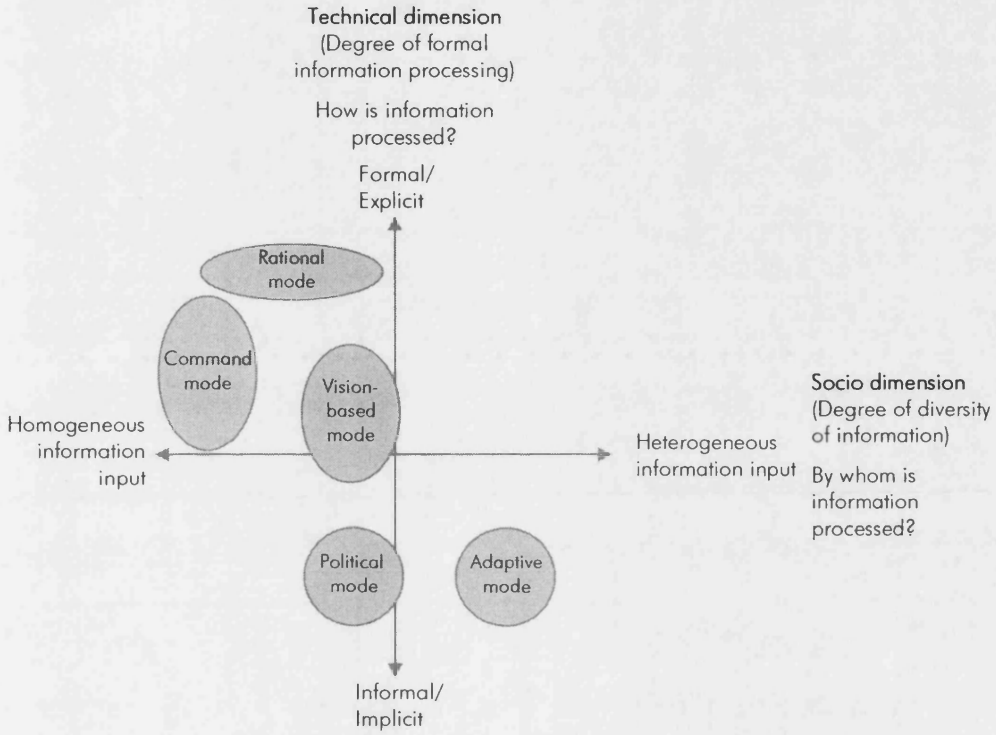

Figure 2.2 – The Socio-technical Effectiveness Framework for Strategy Development Modes

Figure 2.2 displays the five strategy development modes with their approximate positions within the socio-technical effectiveness framework. Adaptive strategy development according to the different definitions of Mintzberg and Waters (1985), Hart (1992), Bailey et al. (2000), Collier et al. (2004) or Mintzberg et al. (1998) is located in the right quadrant. In this mode strategy development focuses on the broad involvement of organisational members, a high degree of heterogeneous information input is the consequence. Adaptive strategy development advocates, on the other hand, less formal ('evolutionary') strategy making over formal planning (Grant, 2003; Pascale, 1999; Burgelman, 1996) and is therefore located in the lower quadrant.

Politics-driven strategy making also stresses a more informal style of decision making. We can conceptualise this bargaining and persuasion-based mode as almost as informal or implicit as the generative mode. However, as power and hierarchy – used in a non-transparent way – play a crucial role in this mode (Mintzberg, 1989), a multiple stakeholder approach is less likely. A more homogeneous information input limited to

political stakeholders is the result. The politics-driven mode can, therefore, be located somewhat to the left of the adaptive mode.

Depending on the culture of the organisation, visionary strategy making relies to a greater extent on explicit formal decision processes than, for example, the adaptive mode. As the organisation has to communicate and further develop a joint vision, one can conceptualise visionary strategy making with somewhat more formal elements than generative and adaptive decision making. As a limited number of people consciously formulate the vision, the approach involves less stakeholders in the decisions than the adaptive mode. Visionary strategy making therefore results in a more heterogeneous information input than the political strategy development.

The command mode is, according to this framework, the most homogenous one. As strategy making in this mode is connected to the experience and intuition of individuals (Mintzberg, Ahlstrand et al., 1998), the command mode is located on the extreme left side of the 'socio' dimension, as displayed in Figure 2.2. As a strong individual leader or small management team exercises control over the organisation (Hart, 1992), explicit formal strategy development processes to connect bottom-up and top-down expertise are less likely than in the rational mode.

The rational mode with an emphasis on planning and formal 'systematic' (Ansoff, 1987) strategy development can be positioned on the top of the technical dimension. The degree of involvement on the socio-dimension might vary depending on the culture of the organisation. However, as a formal planning system usually includes both top-down and bottom up elements, it is can be located between the command and the adaptive mode on the 'socio' dimension.

Conclusion

Approaches to conceptualise 'strategy' are numerous and often ambiguous. Researchers and practitioners have disputed the topic extensively. In particular, Mintzberg's (1998) ten strategy schools provide an integrative perspective on the area of strategy development. As the classification is too broad for this research, this chapter served to contribute to the consolidation of the strategy development literature by establishing a simplified taxonomy of five strategy development modes. The rational, adaptive, visionary, command-based and the political strategy development mode can be classified according to the extent to which they foster information exchange ('socio'

side) and to which they enhance formal information processing (technical side). This adaptive socio-technical effectiveness framework is therefore another core result of this chapter.

Both – the strategy development modes and the socio-technical effectiveness framework – serve in the following chapter to create a conceptual link between socio-technical decision analysis and the area of strategy development. As shown in the next chapter, socio-technical decision analysis incorporates a rational, an adaptive, a visionary, a command-based and a political perspective. All elements are necessary to effectively contribute to strategy making using socio-technical decision analysis.

Chapter 3 – Socio-technical Decision Analysis and Effective Strategy Making

3. Socio-technical Decision Analysis and Effective Strategy Making

The limited issues suppress the limitless ones.

MARA Interview Partner

Theorising about strategy making is often easier than actually doing it. In organisations, when multi-stakeholder decisions have to be addressed, uncertainty resolved and political agendas considered, the urgency of smaller 'operational' problems often severely limits managerial attention for the analysis of strategic issues. Socio-technical decision analysis, as discussed in this chapter, can direct appropriate attention to strategic issues. The objective of this chapter is to develop a link between the characteristics of socio-technical decision analysis (STDA) and its impact in strategy development contexts.

The chapter starts with a description of the core elements of socio-technical decision analysis – communication enhancing decision conferencing and technical modelling. Second, it uses the five strategy development modes, developed in Chapter 2, to outline specific characteristics of STDA when applied to strategic decisions. Changing the perspective from a descriptive to a prescriptive one, this chapter, third, serves to review existing effectiveness studies and to develop a model of how to effectively develop strategies using socio-technical decision analysis. Building on this analysis I, finally, outline the research hypotheses of this PhD thesis.

3.1. Core Elements of Socio-technical Decision Analysis

The objectives of socio-technical decision analyses are twofold. Applied to an organisation's strategic decision, the approach aims to integrate a variety of relevant views of key stakeholders in the decision process ('socio' side). The fundamental objective is to help the group to become committed to a joint way forward (Phillips, 2006). On the technical side, the STDA process provides an explicit and formal way to process a large amount of information, especially in decision situations where options are numerous (Rao and Jarvenpaa, 1991). One fundamental objective on the technical side is a reduction in complexity in complicated decision situations. Both sides are explained in more detail in the following sections.

Decision Conferencing as the 'Socio' Element of STDA

At the end of the 1970s, Decision and Designs Ltd developed the decision conference approach by 'accidentally' organising a meeting with a large amount of key decision makers, who explored the strategic issues facing their company (Phillips and Bana e Costa, 2007). Since these early experiments, on-the-spot modelling using impartial facilitator-guidance is one of the key features of decision conferencing (Phillips, 2006). Facilitators thereby act as process consultants, contributing to process rather than to content (Schein, 1999). Further elements include the attendance of key players and interactive as well as iterative group processes (Phillips, 2006; Rohrbaugh, 1992). The objectives of a decision conference are to create a shared understanding of the issues at stake, to develop a sense of common purpose and to gain commitment to a joint way forward, while preserving individual paths (Phillips, 2006). Figure 3.1 gives a schematic explanation of the decision conferencing process.

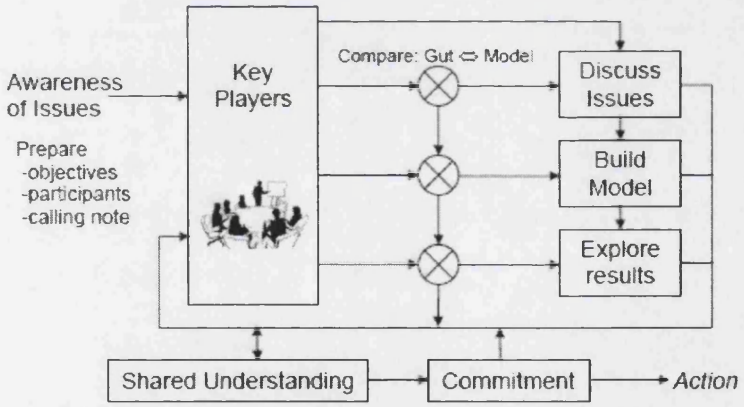

Figure 3.1 – The Decision Conference Process (from Phillips, 2006, p.10)

Recent applications of decision conferences include long-term environmental planning in Hungary (Vari and Rohrbaugh, 1996), tender evaluation in the public sector (Bana e Costa, Correia et al., 2002), water resource planning in South Africa (Stewart, 2003), the evaluation of flood control measures (Bana e Costa, Da Silva et al., 2004), the formulation of a recommendation to manage nuclear waste in the UK (Phillips, 2006) and the six MARA case studies outlined in this PhD research. For a more detailed review of applications, see Phillips (2006) or Rohrbaugh (1992).

Decision Modelling as the 'Technical' Element of STDA

Socio-technical decision analysis, as developed at the London School of Economics, commonly relies on multi-attribute utility models (Keeney and Raiffa, 1976) to tackle problems with multiple and conflicting objectives. According to Phillips and Bana e Costa (2007), this is an ubiquitous problem structure in the public (Bana e Costa, 2001) and the non-profit sectors (Quaddus, Atkinson et al., 1992), and typical of many problems in the private sector (Collins and Porras, 1996). The approach is based on the standard additive value model $V_i = \sum_j w_j v_{ij}$, with v_{ij} representing the value associated with the consequence of option i on criterion j, and w_j representing the weight assigned to criterion j. The total value score for one option can be calculated as the sum of the weighted scores on the individual criteria.

Adding complexity to strategic decisions, decision makers often face a variety of decision options, 'silo-thinking' of individual organisational units and multiple intra-organisational stakeholders (Phillips and Bana e Costa, 2007). In these situations, decision models provide valuable help in order to efficiently process information (Quaddus, Atkinson et al., 1992; Rao and Jarvenpaa, 1991).

The decision model is part of a group decision support system (GDSS). DeSanctis and Gallupe (1987) classify decision conferencing as Level 2 GDSS because of its extensive use of computer modelling. GDSS of this type should, according to Phillips (1989), be *problem focused* in order to help participants deal with the issues of concern, *processing-oriented* in order to aid the thinking of the group rather than contributing to content, *transparent* in order to create reliable results, *theoretically sound* and *flexible*, as well as *adaptable* to the group's needs. The system should aid decision makers to consider trade-offs, preferences and risk attitudes, thereby providing a more rational language with which to discuss the strategic issues at stake. Examples of decision models are described in the framework of the MARA 2006 cases in Chapter 5.

The decision models outlined above are neither normative, descriptive nor strictly prescriptive. The model does not indicate an ideal state (normative), it does not describe actual behaviour (descriptive), nor does it explicitly tell a group what to do (prescriptive). Instead, we can view the decision analyses as guidance for more effective decision making, with the model results indicating one possible direction, rather than deterministically prescribing it.

Phillips (1984; 1982) calls these kind of 'just-enough' models, 'requisite': *'A model is requisite if its form and content are sufficient to solve the problem. Put differently, everything required to solve the problem is represented in the model or can be simulated by it. A requisite model is a simplified version of a shared social reality.'* (Phillips, 1984, p.35). The approach can therefore be clearly distinguished from more technical models developed by the Stanford School of Decision Analysis (Bond, 1999). Phillips (2006), Phillips and Bana e Costa (2007) and Phillips (1989; 1989; 1984, 1982) provide more detailed explanations of the socio-technical approach.

3.2. Five Elements of Socio-technical Decision Analysis in Strategy Development Contexts

As outlined in Chapter 2, we can classify strategy development modes according to the degree of formal information processing (technical dimension) and the degree of diversity of information processed (socio dimension). Socio-technical decision analysis aims to increase both the degree of formal information processing through the use of decision models, as well as the inclusion of multiple stakeholder perspectives in the strategy making process. Figure 3.2 displays the position of a strategy development mode (solely) based on STDA in comparison to the other modes. The arrows in Figure 3.2 reflect the potential impact of STDA elements in strategy development processes towards greater information exchange and better information processing.

Incorporating STDA in Strategy Development Processes Enhances Information Exchange and Information Processing

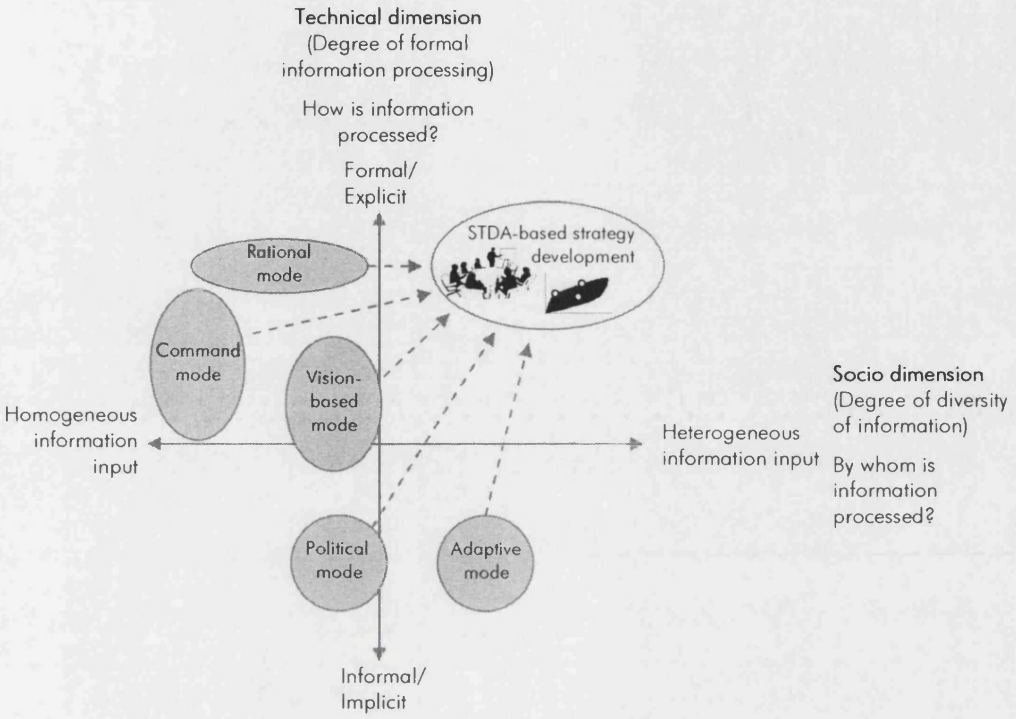

Figure 3.2 – The Socio-technical Effectiveness Framework including STDA-based Strategy Development

STDA itself incorporates elements from each of the five strategy development modes, mentioned in the socio-technical effectiveness framework above. First, the decision model reflects the rational information processing perspective. Second, STDA can lead to intra-case, across-case as well as a process-oriented learning, constituting the adaptive element. The structured elicitation of objectives and the creation of creative alternatives, thirdly, is the vision-based part of the process. The fact that STDA facilitates group alignment, enabling group leaders to move a group in the same direction, incorporates the command perspective. Finally, the negotiations and the information exchange on weights and scores constitute the political perspective. I describe these elements in the following sections in more detail.

The Rational Element

The first decision making paradigms in economics and decision theory viewed the essence of rational decision making as maximising subjective expected utility (Bell and Raiffa, 1988; von Neumann and Morgenstern, 1944). In the last few decades, however,

several researchers have pointed to the shortcomings of rationality as a maximisation task paradigm. They established the bounded rationality model, which includes concepts such as satisficing and aspiration levels (Dean and Sharfman, 1993; Cyert and March, 1963; March and Simon, 1958; Simon, 1955). Psychologists have analysed biases and systematic deviations from the rational decision model (Baron, 2000; Tversky and Kahneman, 1974) and behavioural economists have tried to increase the psychological foundations of economic analysis (Camerer and Loewenstein, 2004). In field settings, however, it is usually very difficult to determine whether an organisation behaves consistently with the predictions of the SEU model (Dean and Sharfman, 1993). Researchers, therefore, usually focus on researching procedural rationality, defined as *'the extent to which the decision process involves the collection of information relevant to the decision, and the reliance upon analysis of this information in making the choice'* (Dean and Sharfman, 1993, p. 589).

STDA focuses on improving procedural rationality. According to Clemen and Kwit (2001) and Clemen (2006), decision analysis provides tools for analysing and framing decisions, helping to overcome bounded rationality. In particular, through decomposing decision problems into smaller units, for example by using multiple criteria rather than scoring decision alternatives holistically, the approach helps to reduce complexity in strategic decisions. On the 'socio' side, an increase in effective information processing also occurs through the structured involvement of relevant key stakeholders, facilitating a more interactive information exchange complementing corporate strategic planning routines.

The Adaptive (Learning) Element

In his 'Learning School', Mintzberg (1998) viewed strategy making as an emergent process, based on acting to stimulate thinking retrospectively. According to his view, strategy making *'...must above all take the form of a process of learning over time, in which, at the limit, formulation and implementation become indistinguishable'* (Mintzberg, Ahlstrand et al., 1998, p. 208).

STDA provides a way to 'try out the future' by using a decision model. In particular, three ways of learning can occur through the STDA process: intra-case learning, across-case learning and process-oriented learning. First, the intra-case learning occurs during the application of STDA when a group builds and explores a

model. The iterative modelling approach aids the generation of new insights into the problem at stake. In strategy contexts, the resulting strategic insights from the modelling process can be fed back into the following year's strategic planning cycle (Schilling and Schulze-Cleven, 2007). In this context, one can view STDA as a strategic 'reflection device' to facilitate strategy relevant meetings.

Second, an organisation can learn over time by applying STDA for several years. Phillips and Bana e Costa (2007), for example, report the case of Allergan Inc., a pharmaceutical company, which reviewed its portfolio of R&D projects using STDA over eight subsequent years. Year after year, the company learned to use STDA more efficiently, allocating resources closer to the overall optimum (across-case learning).

The third type of learning, process-oriented, refers to 'double-loop learning'. According to Argyris and Schön (1978) double-loop learning *'...occurs when an error is detected and corrected in ways that involve the modification of an organisation's underlying norms, policies and objectives.'* (p.3). Similar to double-loop learning, using STDA, an organisation can learn how to improve the quality of strategic decision processes in the long run. These decision process innovations occurred during the MARA projects 'Recruiting Channels' and 'Demographic Change', outlined in Chapter 5. According to the feedback of the project sponsor, the STDA applications revealed inefficiencies in their current resource allocation processes, which they fixed based on the MARA analyses.

The Vision-based Element

The vision-based perspective on strategy development focuses on shared beliefs and values resulting in a collective vision for all actors in an organisation (Mintzberg and Waters, 1985). These values, however, often only exist implicitly in an organisation. Often they are not reflected on organisational charts or in official documents (Jacques, 1998). One objective of STDA is to elicit and construct these values explicitly with the decision makers in order to develop tangible objectives on which decisions can be based.

In this context, Keeney (1992) advocates, as one of the first stages of a decision analysis, the thorough analysis of values and objectives. Decision makers should, according to this approach, separate the fundamental values from mediating 'mean values' in order to construct a consistent objectives hierarchy. They can subsequently use

these objectives networks to creatively construct new alternatives, based on the underlying values (for example, see Keeney and McDaniels, 1999; Keeney, McDaniels et al., 1995; Keeney and McDaniels, 1992). An integrative part of STDA is therefore related to the analysis of conflicting values and objectives. In the MARA case study for the Berlin Senate Government Department for Economics, described in Chapter 5, we extensively applied value-focused thinking to construct a network of conflicting objectives.

The Command-based Element

From a command-based perspective, strategy making is connected to the intuition, judgment, wisdom and experience of an individual leader or a small group of top level decision makers (Mintzberg, Ahlstrand et al., 1998). STDA can enhance command-based strategic decision making from two angles.

First, STDA can help leaders make better informed strategic decisions building on the expertise of relevant key stakeholders in their organisation. It provides a transparent way of effectively integrating different perspectives on a strategic decision. Based on this more heterogeneous information input, the process helps to transfer the newly emerging intuitions into more tangible objectives through a structured process.

Second, STDA can aid senior management to provide directions that others follow willingly (Jacques, 1998). Due to the fact that the authority of individual managers usually decreases when groups rather than individuals make decisions (Jacques, 1998), STDA provides a transparent way for followers to effectively contribute to strategic decisions. The leader and the group contribute to the decision content, whereas the decision analysts provide process support (Schein, 1999). Although the accountable leader will choose final strategies, STDA can align a group towards a joint way forward, while preserving individual paths (Phillips and Bana e Costa, 2007).

The Political Element

The political element of STDA reflects in negotiation-like information exchanges between the participating decision makers. It is possible to view the STDA process as 'quasi negotiations', as it meets two out of three characteristics of classical negotiation situations: conflicting preferences and interdependency of outcomes (Raiffa, Richardon et

al., 2002; Lewicki, Saunders et al., 2001). As the model structure, scores and weights depend on the actions of all actors, the outcome of a decision conference is interdependent on the actors' actions and preferences. Due to existing hierarchies, not every participant of decision conferences has veto power – the third condition for 'classical' negotiations (Raiffa, Richardon et al., 2002; Lewicki, Saunders et al., 2001). STDA processes can therefore be classified as situations similar to negotiations.

In the same way as in negotiations, information sharing by the stakeholders in STDA processes is often not entirely open and transparent. Most decision makers follow their own goals and objectives, which might differ from the objectives of the organisation as a whole. This is one reason for the existence of the 'commons dilemma' (Hardin, 1968) when allocating strategic resources. Although being individually optimal, decisions are rarely collectively optimal, resulting in the inefficient allocation of resources (Phillips and Bana e Costa, 2007). STDA helps to overcome the 'commons dilemma' through transparent processes aimed at improving the overall organisational performance. The model helps to take the 'heat' out of emotionally disputed topics by focusing the discussion on the most relevant issues. A shift from a culture of bargaining and negotiation to a culture of problem solving is often the consequence.

STDA incorporates the five elements, outlined above, to enable effective decision making in strategy development contexts. In the next section, I integrate the rational, the adaptive, the visionary, the command-based and the political elements, to develop a new model for decision effectiveness.

3.3. Effectiveness of STDA in Strategic Decision Making

Only a limited number of models and studies exist to evaluate the effectiveness of strategic decisions in organisations. This section outlines several of these models and studies of effective decision making. An integrative model of effective strategy making using STDA serves to conclude the section.

Existing Effectiveness Models

As even good decisions might produce bad outcomes, it is difficult to link the quality of a decision process with its outcome (Bunn, 1984; Clemen, 1996; Rohrbaugh,

1992). Researchers, therefore, often advocate a focus on the evaluation of the decision process itself rather than on its consequences (Matheson and Matheson, 1998; Dean and Sharfmann, 1996; McCartt and Rohrbaugh, 1989). Pointing in a similar direction, Timmermans and Vlek (1996) distinguish between outcome criteria, which refer to the ultimate quality of a decision's actual consequences, and process criteria, which refer to the perceived correctness of the decision making process. The following effectiveness models focus primarily on process criteria, which Clemen (2006) calls 'weak effectiveness' criteria – models which are concerned with improving decision processes.

As one of the first authors, Phillips (1984) outlined a model to improve decision effectiveness by using 'decision technology'. His model relies on three components: people, information technology and preference technology as outlined in Figure 3.3. The problem owners, first, contribute the necessary experience, intuition and knowledge that are essential to solving the problem at hand. Information technology, second, enables problem owners to store, process and analyse relevant data, as well as model the possible consequences of future actions. The third component of the model, preference technology, aids decision makers to clarify subjective value judgments, risk and time preferences, as well as trade-offs. When these three components interact, those involved can, according to the author, make a decision effectively. The decision effectiveness model presented below integrates the difference between preference modelling and information processing of Phillips (1984).

One criticism of this model relates to the fact that the interface between preference technology and information technology is unclear. It is difficult to separate information technology to *'...determine possible future consequences of pursuing different alternatives'* (Phillips, 1984, p. 81) from preference technology, which *'...helps to clarify subjective value judgments made when evaluating possible consequences of different courses of action...'* (Phillips, 1984, p. 81).

In strategic R&D decision making – a domain where the outcomes of decisions in the short-term are especially difficult to observe – decision makers are often in particular concerned about the effectiveness of decisions. Matheson and Matheson (1998) developed in this context a 'decision quality' chain consisting of six dimensions. According to this model, a decision can, first, only be of a high quality when decision makers choose the *appropriate frame* – the correct background and context – to solve the right question. Second, *creative, workable alternatives* are the condition for high-

quality decisions. Third, to evaluate these alternatives, *meaningful, reliable information* is necessary. Fourth, based on this information, decision makers should make a decision based on *clear values and trade-offs*, especially taking risk preferences into account. *Logically correct reasoning* is then necessary to determine which alternative creates the highest value. Finally, *commitment to action*, through the meaningful involvement of the right people concludes an effective decision process. Matheson and Matheson (1998) advocate a decision to be of high quality if it scores highly on each of these dimensions. Figure 3.3 visualises this decision chain. These steps have been integrated in the integrated decision effectiveness model, presented below.

The most important criticism of this decision quality model relates to measurement difficulties. The authors advocate a survey-based test, which can be used to evaluate organisations based on data provided by organisational members (Matheson and Matheson, 2001). The dimensions include an implicit value statement, such as that more alternatives are better than less alternatives. The framework, therefore, was mostly inapplicable for the evaluation of the effectiveness of STDA. The approach presented in this thesis allows for assessment of an ideal point on a scale, as implicit value statements can not usually be generalised to a variety of different organisations. Chapter 4 and Chapter 6 serve to outline more details on the questionnaire development.

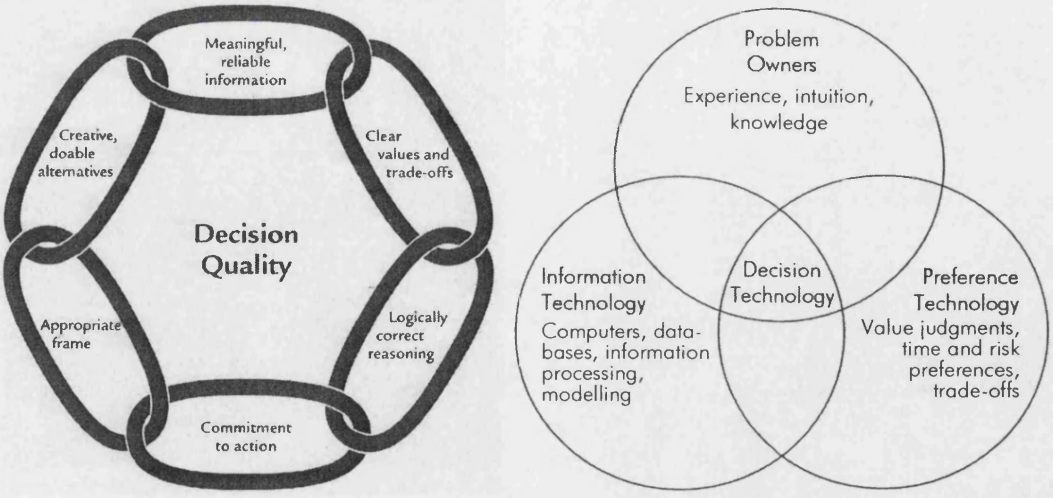

Figure 3.3 – Decision Effectiveness Models (left: from Matheson & Matheson, 1998; right: from Phillips, 1984)

Used as a basis for several decision evaluation studies, Quinn and Rohrbaugh (1981, 1983) developed the competing values framework (CVF) by structuring the judgments of organisational researchers on criteria which serve to evaluate the

performance of organisations. The authors later transferred this framework to evaluate the effectiveness of group decision processes (McCartt and Rohrbaugh, 1989, 1985). Four perspectives emerged, which Figure 3.4 displays below.

The *empirical perspective* stresses the importance of information and documentation in an effective decision process. The *rational perspective* emphasises clear thinking rather than empirism as the primary component for effective decision making. The *political perspective* favours flexibility and creativity in decision processes. Finally, the *consensual perspective* focuses on participation in decision processes. According to the authors, a decision is effective if it represents all of these perspectives accordingly (McCartt and Rohrbaugh, 1995).

Consensual perspective Effectiveness criteria: - Participatory process - Supportability of decision	**Political perspective** Effectiveness criteria: - Adaptable process - Legitimacy of decision
Effectiveness criteria: - Data-based process - Accountability of decision **Empirical perspective**	Effectiveness criteria: - Goal-centered process - Efficiency of decision **Rational perspective**

Figure 3.4 – The Competing Values Framework for Group Decision Processes (adopted from McCartt and Rohrbaugh, 1989 and McCartt and Rohrbaugh, 1995)

Various criticisms of the Competing Value Framework exist. The CVF vaguely conceptualises information processing – an essential part of an effective decision process (Dean and Sharfmann, 1996). Whilst the empirical perspective stresses the collection of relevant data, the rational perspective emphasises clear thinking and goal focus. However, a clearly thought through decision without the inclusion of some data is hard to imagine. For every decision, externally gathered data, internal preferences or value judgments usually exist. On the other hand, thorough data collection in an 'empirical mode', without a subsequent analysis, is also difficult to imagine. Therefore, in the integrated model on decision effectiveness presented below, these different perspectives have been integrated separately in different stages of a decision process.

Integrated Effectiveness Model

Integrating some characteristics of the existing decision effectiveness approaches outlined above, in the following section, I present a model for effective strategic decision making using STDA. The model outlined in Figure 3.5 aims to capture the complexity reduction effect of STDA when applied in strategic decision situations. The framework divides information processing in two phases: a divergent and a convergent information processing phase. After an initial stage, when the initial objectives of the strategy analysis are defined, usually the degree of 'information fuzziness' increases. In the second phase, STDA helps to reduce this information 'fuzziness' and complexity by identifying the relevant decision elements, by creating group alignment and by generating insights into strategic choices to finally make an effective decision.

Through the discovery of new issues, such as a re-definition of the objective of the analysis, additional sources of uncertainty or new objectives, usually the degree of 'fuzziness' of the analysis increases in the first phase. This phase refers to the empirical perspective of the Competing Value Framework (McCartt and Rohrbaugh, 1995) and the collection of 'meaningful reliable information' of the effectiveness model of Matheson and Matheson (1998). In the second (convergent) phase, a decision model helps to direct attention to potentially decision relevant information. The rational perspective of the Competing Value Framework, the preference & technology stage of Phillips (1984) and several components of the decision effectiveness models of Matheson and Matheson (1998) reflect this stage, when values and objectives as well as the identification of relevant alternatives are constructed. Shaping values during the STDA-based process especially relates to the visionary element of STDA. The modelling part captures the rational part of the strategy development elements, outlined above. One can position the political element of STDA across the whole process as intra-group negotiations are omnipresent.

As an outcome of the process, insights into strategic decision situations emerge, as well as the alignment of the participating decision makers. The consensual perspective of the CVF and the 'commitment to action' element of Matheson and Matheson (1998) relate to this stage. As insights into strategic decision situations are connected to learning, this phase relates to the adaptive element of STDA. The alignment effect, on the other hand, helps leaders to move the group towards a joint way forward and is, therefore, connected with the command element of STDA. The strategic insights

generated can then be fed into the next analysis cycle. Figure 3.5 depicts the integrative effectiveness model.

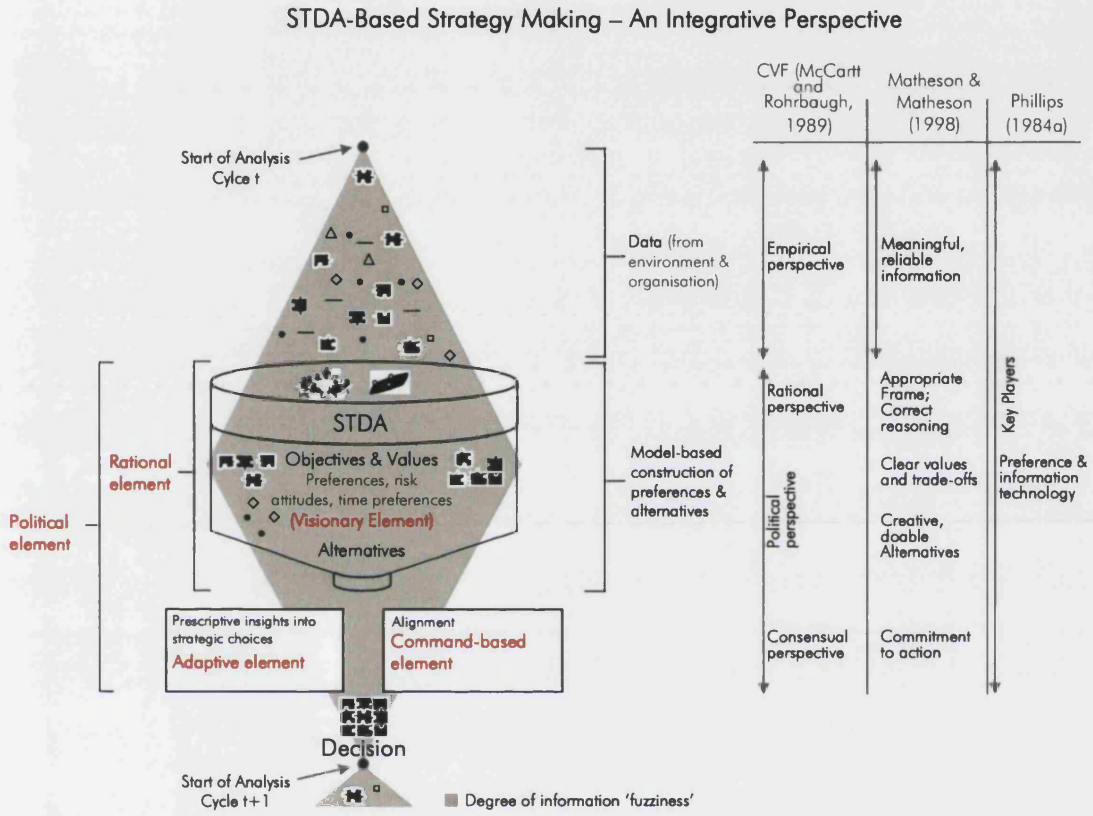

Figure 3.5 – An Integrative Perspective on STDA-based Strategy Development

Using the integrative decision effectiveness model outlined above, a strategic decision process can now be defined as effective when all five elements of STDA are present. An effective decision should be based on an effective information exchange between the relevant key stakeholders (political element). The group should adequately address decision specific values and use them to find creative alternatives (visionary element). It should use a transparent and comprehensive process to create a decision model (rational element). During the process, the group should learn about strategic insights into the problem at hand (adaptive element) and be aligned towards a joint way forward (command-based element).

These five elements together with experts interviews, described in Chapter 4, served as a basis on which to develop specific dimensions to test the process effectiveness of STDA. The related hypotheses for the effectiveness studies described in this PhD thesis, as well as previous studies, are outlined in the next section.

Existing Effectiveness Studies & Research Hypotheses

One objective of this research is to contribute to the limited body of knowledge in the area of decision effectiveness. Effectiveness studies can be classified as those focusing on 'strong effectiveness' (Clemen, 2006) – the relationship between the quality of decisions and the related consequences. Macmillan (2000), for example, is one of the few researchers who followed this path by analysing the influence of the use of decision analyses in the UK oil and gas industry. In her study she showed that a high degree of sophistication of decision analyses applied correlates positively with better organizational performance, measured beyond others with return on equity, analysts' company valuations or price earning ratios. As data on organisational performance is usually inaccessible in a reasonable timeframe, most studies, however, focus on the quality and degree of rationality of the decision processes (Dean and Sharfmann, 1996; McCartt and Rohrbaugh, 1989) – the 'weak effectiveness' (Clemen, 2006). This work follows this procedural rationality focus by evaluating the process effectiveness and the alignment effect of STDA. Existing effectiveness studies are outlined below, together with the resulting hypotheses of this research.

McCartt and Rohrbaugh (1989), for example, analysed the perceived effectiveness in 14 decision conferences based on the Competing Value Approach. Participants rated decision conferences as most effective when they believed that a decision would actually be taken. In addition, the perceived effectiveness increased in particular through the presence of an outside facilitator. In a later study, the authors analysed 26 decision conferences, mainly in the public sector (McCartt and Rohrbaugh, 1995). Participants perceived the interventions as most successful in flexible organisations which are open to change, where the number of participants was low and the participants felt that an important decision was on the agenda.

Rather than relying on judgments of decision makers, Clemen & Kwit (2001) analysed the effectiveness of their decision analyses at Eastman Kodak Company, measured as expected value of analysis. The authors calculated the expected net present values of the different alternatives analysed. By comparing the value of the chosen strategy and the 'momentum strategy' – the strategy which the company probably would have chosen without doing an analysis – they computed the expected net present value of the analyses. The authors identified considerable financial value of the decision

analyses, recognising that the calculations do not take into account advantages on non-monetary dimensions, such as an improved understanding of risk or the use of systematic decision principles.

Using a comparative approach, Chun (1992) asked participants in 22 decision conferences in the UK and the US to compare the effectiveness of STDA with ordinary meetings. Participating decision makers rated the decision conferences consistently higher than ordinary meetings on the decision process dimensions, participation, information access, adaptability, legitimacy, efficiency, goal centred processes, accountability, and supportability of the decision. As usually well-prepared external analysts organise decision conferences, the results of Chun (1992) may not be surprising. In addition, decision makers could not state ideal points on the measurement scales to indicate, for example, dissatisfaction with both the status quo processes and the intervention. Focusing not only on Decision Conferences, but on the whole STDA process, this PhD research takes this kind of process effectiveness analysis a step further.

The core hypothesis of this work is therefore that STDA is more effective than existing methodologies in some strategy related decision contexts. Two studies serve to assess the effectiveness of STDA:

In the first study, we measured perceived effectiveness of the decision makers who participated in an STDA process. As outlined in Chapter 4, 26 in-depth interviews with practitioners resulted in three 'socio', three technical and two result-oriented dimensions to assess the effectiveness of STDA. The participating decision makers assessed STDA, a hypothetical ideal state and the current status quo of the existing decision processes on the eight dimensions. This approach seemed appropriate as the notion of effectiveness always includes some kind of value statement (Campell, 1979). As described in Chapter 4, MARA 2006 served as a research setting, consisting of six comparable case studies, to create a thorough and holistic picture of the effectiveness, the strengths and the weaknesses of STDA. Chapter 6 describes details of the research hypotheses of this decision process effectiveness study.

The second study focuses on the effectiveness of STDA in relation to group alignment effects. It measures alignment of the preferences of the decision makers for the options under consideration before and after the modelling process. The hypothesis is that STDA aids groups to come to a common understanding on the joint way forward, measured by a shift in preferences towards the modelling results when comparing

preferences before and after the application. Chapter 6 serves to outline the specific set-up of the alignment study and the results of the alignment research.

Conclusion

Strong links between socio-technical decision analysis and the strategy development literature exist – but have not yet been explored intensively. This chapter has served to develop these connections more thoroughly, using the simplified taxonomy of strategy development modes, presented in Chapter 2. STDA can therefore be interpreted as incorporating a rational, an adaptive, a visionary, a command-based as well as a political element. In the socio-technical effectiveness framework, as introduced above, strategy development solely based on STDA leads to a more extensive exchange of information as well as more formal information processing in comparison to the other strategy development modes.

To test whether STDA is in fact more effective on a socio and a technical dimension than existing strategy development processes, the following chapters describe two empirical studies on the perceived effectiveness of STDA and group alignment effects. An applied research project – MARA 2006 – served to carry out these studies. The next chapter outlines details of this research framework as well as the empirical methods used.

Chapter 4 – Research Methodologies

4. Research Methodologies

Impossible is just a big word thrown around by small men who find it easier to live in the world they've been given than to explore the power they have to change it. Impossible is not a fact. It is an opinion. Impossible is not a declaration. It's a dare. Impossible is potential. Impossible is temporary.
Impossible is nothing.

Adidas Promotion Slogan, Global Promotion Campaign 2004

The idea behind the research framework of this thesis builds on an impressive effort made by a group of young, dedicated Argentinian and German researchers in 2005 in Buenos Aires. Where aggressive crowds had burnt tyres and smashed windows during the economic crisis only two years previously, this group organised a newly designed research project in the area of decision analysis. Thirty international participants, two international ambassadors, the Argentinian Minister of Science and several subsidiaries of German Blue Chip companies, participated in MARA 2005. The above-cited quote reflects this joint effort, which led a seemingly impossible project to success.

The follow-up project in Germany, MARA 2006, served as the basis on which to carry out the empirical studies of this research project. The objective of this chapter is to outline the research context of these studies. Following a summary of the research questions of this work, the second section of this chapter describes the details of the MARA 2006 project. The third section outlines the research elements of MARA 2006: first, the case studies, created within the framework of MARA 2006, second, the in-depth interviews with strategic decision makers to generate and evaluate decision effectiveness dimensions. Third, based on these dimensions, the chapter outlines the survey to test the perceived effectiveness of STDA and, finally, the field study to measure the alignment effect of the MARA interventions. In the following sections, I also discuss the limitations and the quality of the research elements in relation to objectivity, reliability, (construct) validity and generalisation (external validity).

4.1. The Research Questions

MARA 2006 and the theoretical part of this PhD research aim to address the following research questions related to the effectiveness of STDA:

- Do decision makers perceive socio-technical decision analysis as effective in comparison with existing strategic resource allocation approaches?
- What are the core strengths and weaknesses, as well as the possibilities for improving the approach?
- Is STDA effective regarding the alignment of the preferences of the participating decision makers?

In this chapter and in Chapter 6, I describe the research results in relation to these questions – in particular the development of the effectiveness dimensions, the results of the effectiveness survey and the alignment study. In addition, this research aims to conceptually advance STDA:

- How can STDA be theoretically integrated in the field of strategic management, in particular in the existing literature on strategy development processes?
- How can STDA be practically enhanced to increase its effectiveness in strategy development processes?

Whilst Chapters 2 and 3 serve to integrate STDA in the literature, Chapter 7 addresses the more practical issue of enhancing STDA in strategy development contexts. The project MARA 2006 was specifically designed to address these issues. The next section describes this research context in detail.

4.2. The Research Context of MARA 2006

MARA is an abbreviation for the Spanish name 'Methodologías para la Asignación de Recursos: Argentina/Alemenia' ('Resource Allocation Methodologies: Argentina/Germany'). I developed this project idea in the summer of 2004 with the purpose of transferring socio-technical decision analysis to geographical regions where decision analysis was less well-known than in the UK and the US. Together with a fellow PhD student from the LSE and two assistant professors from the University of Buenos Aires, we developed and organised the non-profit project in 2005 in Argentina. With an enhanced concept, in particular for more thorough research, our team organised the MARA 2006 project in Germany. The project development cycles, from the initial idea to the presentation of the final results, were 15 months for MARA 2005 and 12 months for MARA 2006. The organisers and participants spent approximately 2,250 man days preparing MARA 2006, training participants, creating the six case studies and documenting the results.

The aim of the following sections is to provide information to enable the replication of this research setting in other contexts – for example with the purpose of testing the reliability of the research results.

MARA 2006: The Core Idea

MARA is a project located at the interface between decision analysis and practice. During MARA a group of relatively inexperienced PhD students and young professionals applied STDA in practice. The core idea relates to the 'meta topic' of this PhD research: to test whether socio-technical decision analysis can be applied effectively by a group of relatively inexperienced analysts. To build up technical skills, senior academics from the area of decision analysis trained this international and interdisciplinary group. In teams of four to six members, the participants applied STDA in five different projects in both private and public sector organisations. The MARA team purposefully developed the project in a 'real-world' setting, rather than in a laboratory-like test environment. Subsequent publications aim to feed back the knowledge created through the applied research into the scientific domain. Figure 4.1 outlines the MARA knowledge creation cycle.

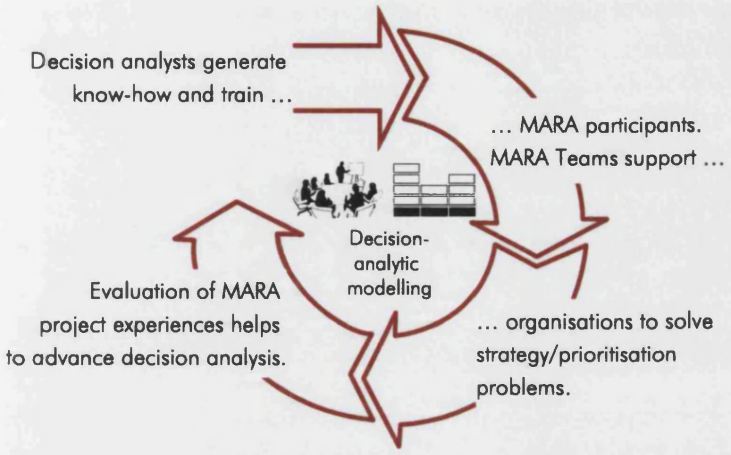

Figure 4.1 – MARA Knowledge Creation Cycle

The MARA 2005 and MARA 2006 projects aimed to fulfil two major objectives: to create new scientific knowledge and to transfer knowledge from the area of decision analysis to partners and participants. The research opportunities were in particular appealing. The close connection which the MARA teams established with the partner organisations offered the valuable opportunity of accessing top-level decision makers for research purposes. In this context, both projects served to create case studies, comparable in size and methodological scope. The eleven case studies of MARA 2005 and MARA 2006 provided an excellent opportunity to test socio-technical decision analysis in a variety of different, yet comparable contexts.

In order to create an institutional framework within which to carry out these projects, three colleagues and I founded a foundation in Argentina (Fundación MARA) and a research institute in Germany (Centre for Decision and Negotiation Analysis / Decision Institute)[1]. MARA 2006 – the basis for this PhD research – was supported by the German Minister for Education and Science, the British Ambassador to Germany, as well as the Director of the London School of Economics. In addition, the German Academic Exchange Service, the Foundation of German Business and A.T. Kearney acted as partners in the project. The Hertie School of Governance in Berlin provided contacts and content-related assistance for MARA 2006.

[1] Information on the Fundación MARA is available at www.mara.org.ar, Information on the Centre for Decision and Negotiation, which we re-named the 'Decision Institute', is available at www.decisioninstitute.eu.

MARA 2006: Project Outline

MARA 2006 consisted of four phases: a Project Development Phase, a Training Phase, an Applied Research Phase and a Documentation Phase.

Project Development Phase

The development of MARA 2006 started in November 2005, after the presentation of the MARA 2005 results at the Annual Meeting of the Institute of Operations Research and Management Science (INFORMS) in San Francisco. In approximately 750 man days, until June 2006, a team of nine people developed the framework of MARA 2006 – work which mainly comprised the acquisition and pre-modelling of sub-projects, human resources tasks and logistics. We contacted 53 organisations and ultimately obtained four project-sponsoring organisations, together with several supporting foundations and universities. In addition, the MARA HR team (three part-time organisers led by Cornelius Schaub, a fellow PhD student) hired 24 participants and team leaders.

Together with Paul Schulze-Cleven, a participant in MARA 2005, I pre-developed the models for the six case studies, so that the MARA 2006 teams could finish their work within the ten-week timeframe which followed the Training Phase. Below, I set out the details of my contributions to the project, a description of the MARA outline and the participants' profiles.

Training Phase

The Training Phase served to provide MARA participants – who for the most part had not yet been trained in decision analysis – with methodological knowledge. The Training Phase consisted of several modules in Berlin. This phase included: a one-day negotiation seminar with a modelling introduction, a five-hour soft-skill/presentation training session, a one-day introduction into Multiple-criteria Decision Analysis and a three-hour session on the experiences gained in MARA 2005.

Senior academics from the area of decision analysis organised the second part of the Training Phase in a management training location outside Berlin. The purpose of the off-site training was to provide MARA participants with practical experiences in order to model decision problems and to enhance group dynamics so that the teams could collaborate effectively during the Applied Research Phase. The 9-day training consisted of three modules:

- Multiple-criteria Decision Analysis and Decision Conferencing,
- Risk Modelling and
- Value-focused Thinking

All three modules included theoretical sections and group modelling exercises. We selected suitable senior experts based on international reputation and ability to provide participants with a wide variety of methodologies with which to work in the Applied Research Phase. A half-day 'MARA Strategy Session' completed the Training Phase and served to link decision analysis to strategy development, providing some first insights into the area of strategic management.

Applied Research Phase

In this phase, the five MARA teams worked on six projects for four partner organisations. To create these case studies, 31 participants, organisers and team leaders worked approximately 1,500 man-days in ten weeks from June to September on the following topics:

- Recruiting Channel Optimisation for Deutsche Bahn AG
- Portfolio Analysis on Internal Demographic Change for Deutsche Bahn AG
- Investment Prioritisation for DB Station & Service AG
- Prioritisation of Infrastructure Funding Request for the Berlin Senate Government Department for Economics (SenWAF)
- Appraisal of Research Directions for the Ferdinand-Braun Institute für Höchstfrequenztechnik (FBH)
- Portfolio Analysis of Research Strategies for Ferdinand-Braun Institute für Höchstfrequenztechnik (FBH)

To ensure high quality standards of the six case studies, each team consulted on a weekly or bi-weekly basis with the MARA Steering Committee during the Applied Research Phase. The committee consisted of a fellow PhD student, a young professional, who participated in MARA 2005 and myself. In these advisory sessions, we reviewed the progress of each project and agreed on the next modelling steps. In addition, every two weeks, the team leaders met separately with the steering committee to discuss intra-team issues and to exchange knowledge. Two 'Project Progress Meetings' during the Applied Research Phase for all MARA participants, provided an opportunity for the teams to exchange relevant modelling knowledge.

The five teams spent the most time with the clients at the beginning and at the end of the Applied Research Phase. Two time-intensive activities account for the two peaks around Week 2 and around Week 8 in Figure 4.2: following an introduction week for the teams with little client contact, in Week 2 we introduced the project teams to the clients and further clarified the analysis. In Week 8, we carried out most of the decision conferences, so the clients invested a particularly high amount of time. Figure 4.2 displays the cumulative hours spent with clients across the teams.

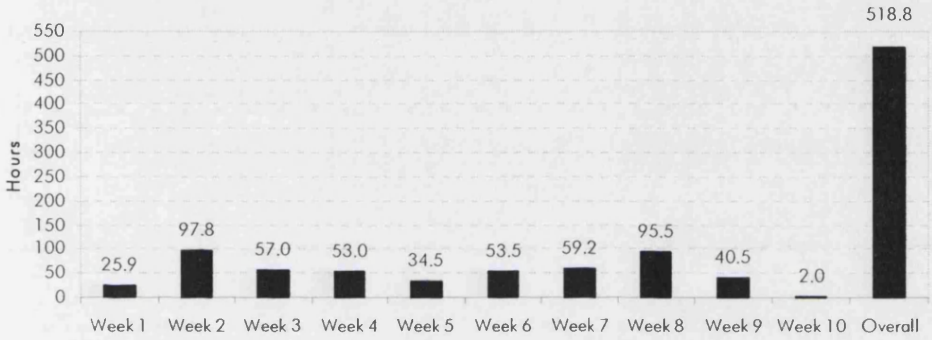

Figure 4.2 – Total Hours of MARA 2006 Teams spent with Clients

The teams spent 518.9 client hours in total within the framework of MARA 2006. This time was distributed unevenly across the six MARA 2006 projects. The decision problems for the three Deutsche Bahn projects were particularly complex and accordingly a considerable amount of time was necessary to clarify the framing of these models. The DB teams therefore spent 81.6% of the accumulated time of MARA 2006 with their clients (423 hours out of 518.8 hours). The complexity of the projects for SenWAF and FBH can be classified as equally complex in scope – both teams spent approximately 47.5 hours out of 518.8 hours (9%) with the decision makers.

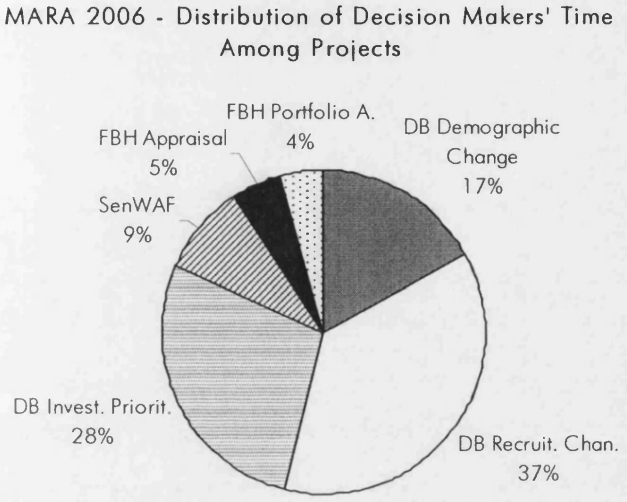

Figure 4.3 – Time Spent with Clients for each MARA 2006 Team (in total: 518.8 hours)

Documentation Phase

MARA 2006 concluded with a one-week Documentation Phase, with the purpose of consolidating the results of the analyses and preparing the Final Conference. The results of MARA 2006 were also presented at the Annual Meeting of INFORMS in November 2006 in Pittsburgh, where the project for the Ferdinand-Braun-Institute was nominated for the INFORMS Practice Award 2006.

MARA 2006 Participants

The involvement of a group of relatively inexperienced participants, but with sound academic and interdisciplinary backgrounds, was a key factor for the success of MARA 2006. On the micro level, a young professional or student, usually with some previous modelling experience, led each team. For the larger teams, which worked for FBH and SenWAF, an 'Associate Team Leader' assisted the team leader in leadership tasks. The team sizes varied from three (DB Recruiting Channels) to six (FBH) members. Each team consisted of at least one student from the London School of Economics, studying for his/her Masters in Decision Science. In addition, in every team up to three native German speakers enhanced communication with those clients who did not have a sufficiently high level of English. Six of the participants were under-graduates, 21 were graduates and four, PhD students. Figure 4.5, 4.6 and 4.7 outline the relevant universities, nationalities and fields of study of the MARA 2006 participants.

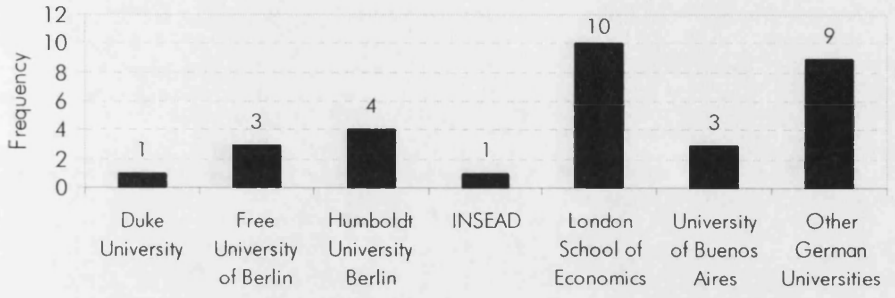

Figure 4.4 – Corresponding Universities of MARA 2006 Participants

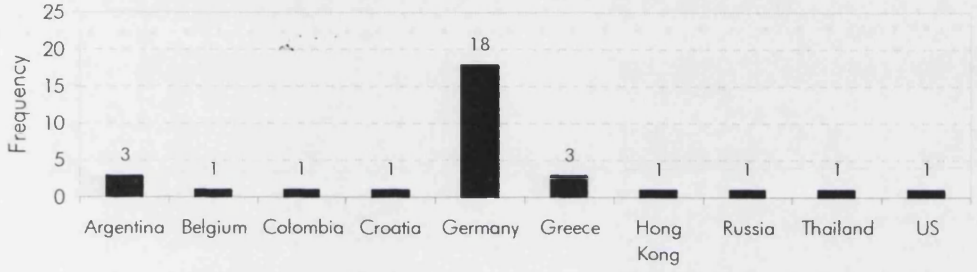

Figure 4.5 – Nationalities of MARA 2006 Participants

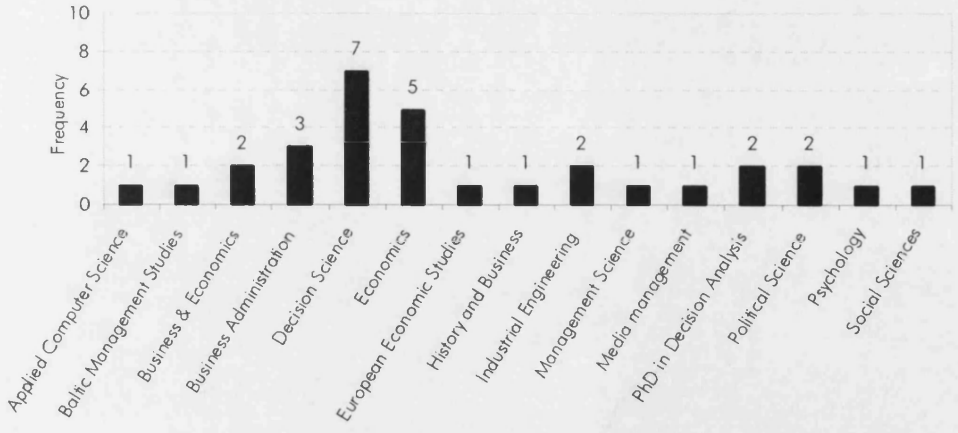

Figure 4.6 – Fields of Studies of MARA 2006 Participants

The Author's Contribution

As outlined above, MARA was the joint effort of a team of 31 students and young professionals. The results of MARA can therefore be attributed to the group as a whole. Having focused on setting-up a suitable PhD research environment with MARA 2006, I made the following contribution to the success of the project:

- The creation of the core idea of MARA as an applied research project
- The acquisition of four partner organisations, which sponsored six projects, and several supporting organisations, such as the London School of Economics and the Hertie School of Governance (assisted by a three-person project development team)
- Pre-development of the six MARA case studies, including model outlines, which ultimately served as the basic structure of the final models
- Supervision of the development of the six cases and the preparation of the decision conferences (together with the project development team)
- Development of the research setting, in particular the decision process effectiveness dimensions, the effectiveness survey and the alignment study (together with Professor Larry Phillips and one MSc student)
- The design and conduct of the interviews both before and after the MARA intervention
- Development of the research documents and supervision of the research assistants within the project teams
- Analysis and documentation of the results (assisted by an assistant researcher)

Having described the research setting of MARA 2006, in the following section, I outline and classify the five research elements of MARA 2006.

4.3. The Five Research Elements of MARA 2006

MARA 2006 served as a unique research setting in which to analyse the research questions outlined in Section 4.1. To achieve effective knowledge creation, we formulated an embedded research design with multiple case studies and multiple data collection methods ('triangulation') (Remenyi, Williams et al., 1998; Eisenhardt, 1989).

The evidence collected was therefore qualitative and quantitative, using the following research elements:

- before the start of the Applied Research Phase of MARA 2006, thirteen in-depth interviews to create dimensions with which to measure the perceived effectiveness of STDA,
- six MARA 2006 case studies to analyse the current strategic decision processes in the participating organisations and develop model-based suggestions for improvement,
- a decision effectiveness survey to measure the perceived effectiveness of these STDA applications,
- an alignment study to measure the preferences of the decision makers with regard to the options under consideration before and after the STDA application and
- to evaluate the impact of the STDA approaches, thirteen ex-post interviews, which created the basis on which to collect further evidence on the structure of the effectiveness dimensions.

MARA 2006 contained research elements both of a positivistic and a social constructivistic nature. The positivistic research paradigm views research as an inquiry into an external, objective reality with law-like generalisations similar to natural science (Remenyi, Williams et al., 1998). Phenomenologists or social constructivists usually reject such a strict separation between values and facts. They reason from naturally occurring, but largely uncontrollable, case studies towards 'generalizable' principles (Bonoma, 1985). According to this socially constructed view, the researcher is not independent of the subject of research (Remenyi, Williams et al., 1998). This perspective is closely related to the Indeterminancy Principle, which Werner Heisenberg formulated in 1927, which states that *'...it is never possible to obtain full and objective information about the state of a body, because the act of experimentation itself will determine the observed state of the phenomenon studied.'* (Easterby-Smith, Thorpe et al., 2002, p.32).

In the context of MARA 2006, research elements based on the social constructivism perspective served to inductively create theory, whilst the more positivistic elements served to test theory as displayed in Figure 4.7.

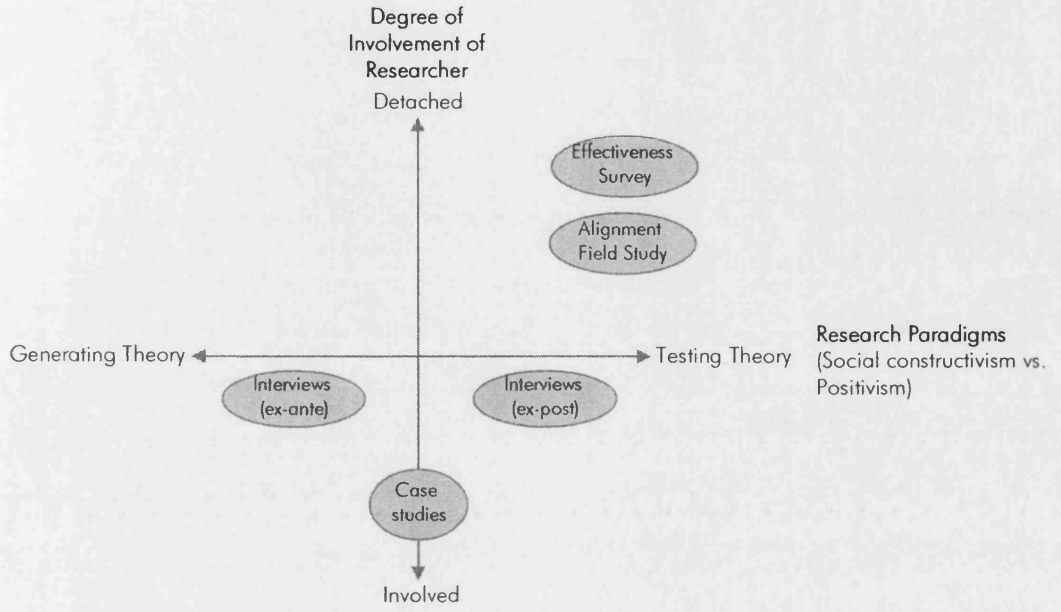

Figure 4.7 – Classification of the MARA 2006 Research Elements (adopted framework from Easterby-Smith et al., 2002)

Whilst the primary objective of the ex-ante interviews was to develop theory, the purpose of the effectiveness survey and the alignment study was more to test the theories developed. One can also locate the ex-post interviews to evaluate the effectiveness of STDA and to confirm the effectiveness dimensions on the side of testing theory. The case studies take an intermediate position, as they not only aided the creation of new theory as outlined in this thesis, but also served to test the hypothesis that STDA can aid effective strategic decision making. All of these elements are related to different degrees of involvement of researchers. As the MARA teams worked with the clients on site to jointly develop models, they were the most involved at the time of creating the case studies. As the in-depth interviews are a process of listening and dialogue, rather than joint modelling, one can assume the degree of involvement to be somewhat lower than in the interviews. The effectiveness survey can be positioned as the lowest involvement of all research elements, as we only provided the decision makers with an electronic survey form. For the alignment study, we had to interview the decision makers, although in a highly structured way, so that it can be positioned in an intermediate position between the survey and the interviews.

Table 4.1 outlines the objectives, units of analysis, research designs and analysis methodologies applied to each of these research elements.

The Characteristics of the Five MARA Research Elements

	Objective	Unit of Analysis	Research Design	Applied Analysis
Ex-ante Interviews	To create dimensions on which to measure the perceived decision process effectiveness	Strategic decision makers from a variety of private and public sector organisations	Semi-structured in-depth interviews	Content analysis
Case Studies	To develop a set of comparable case studies to gain insights into the effect of socio-technical decision analysis	Group of decision makers aiming to make strategic decisions	Applied research with change-oriented elements (action-research)	Interviews, model building, observations
Process Effectiveness Survey	To measure the perceived effectiveness of STDA in comparison with a hypothetical ideal state and the status quo	Participating decision makers	Questionnaire development and analysis	Descriptive and inference statistics for the quantitative part; some content analysis elements for the qualitative part
Alignment Field Study	To measure the effect of STDA on the preferences of the decision makers	Preferences of participating decision makers	Field study with some quasi-experimental elements (ex-ante and ex-post preference assessment, compared to modeling results)	Descriptive and inference statistics
Ex-post Interviews	To confirm the structure of the effectiveness dimensions and to evaluate the impact of the applications	Participating decision makers	Semi-structured in-depth interviews	Content analysis

Table 4.1 – Overview of the MARA 2006 Research Elements

Due to the different characteristics of these research elements, we can position the MARA research between the positivistic and constructivistic approach. As the sample size in all MARA research elements is relatively small compared to laboratory research, we can use the findings to build theory rather than to generalise to a larger population (Yin, 1989). When describing the research elements in more detail below, I also briefly review the objectivity, reliability, validity and generalisability of the MARA research results. Researchers from different areas define these research quality indicators differently. As the MARA research can be positioned between psychology and management research, I

use a combination of definitions from these two domains, mainly based on Easterby-Smith et al. (2002), Bortz and Döring (1995) and Yin (1989).

We can define *objectivity* in this context as the degree of independence of the results from the researchers (Bortz and Döring, 1995). This can be applied to collecting data, as well as to interpreting results. One interpretation of *reliability* relates to the consistency and stability of the results over time due, for example, to low measurement errors (Remenyi, Williams et al., 1998; Homburg and Giering, 1996; Bortz and Döring, 1995). As the research from the first ex-ante to the last ex-post interviews lasted approximately 10 months, we could obtain some assessment of reliability. In the literature, the concept of validity is defined in various ways. Easterby-Smith et al. (2002), for example, distinguish between internal, external and construct validity. *Construct validity* – the validity definition I use – can be defined as the extent to which the research accurately measures 'the reality', which is used as a primary definition for validity in this research. Finally, *generalisability* can be defined as the extent to which the results can be transferred to a broader domain (Yin, 1989). This notion is closely related to what is known as external validity (Easterby-Smith, Thorpe et al., 2002; Remenyi, Williams et al., 1998; Bortz and Döring, 1995). To assess generalisability, we can define the 'broader domain' as 'resource-based strategic decisions in private and public sector organisations with multiple objectives and multiple stakeholders'.

In the following sections, I outline further details on the research elements, including a brief evaluation of each of them on the four research quality indicators outlined above. Table 4.2 gives an overview of these research quality evaluations.

Research Quality Evaluation of the MARA 2006 Research Elements

Research Quality Measures / Research Elements	Objectivity Degree of independence of results from researchers	Reliability Degree of consistency and stability of results over time due to low measurement errors	Validity Degree of accuracy to measure the phenomenon under observation (construct validity)	Generalisability Degree of transferability of results to a 'broader domain' (external validity)
Interviews	Interview guidelines used for all interviews to increase objectivity; Transcripts and protocols analysed by several researchers	Results of ex-ante and ex-post interviews regarding socio and technical dimensions were consistent	Interactive nature of research allowed thorough exploration of validity of the statements	High variety of different perspectives included to be able to generalise decision effectiveness dimensions across organisations and sectors; but: sample size for interviews is commonly low in comparison to other research instruments
Case Studies	Comparison of initial model proposals of MARA steering committee, developed before MARA, with final models of teams, were highly consistent; different teams would probably have produced similar results, however, with some variations in details	Not assessed as cases were unique with respect to the problems solved	Multiple source of evidence used (interviews, observations, modelling) to increase validity	Not assessed as cases were unique with respect to the problems solved
Decision Effectiveness Survey	Standardised survey with thorough explanation sent via email to increase objectivity	Clearly written instructions on survey to ensure reliability of measurement, Cohen's Kappa for evaluation of qualitative statements $\kappa_{Total} = 0.80$	Questions asked for perceived effectiveness – high validity can be assumed	Due to clearly set-up research setting, similar effect of STDA in related settings probable; however MARA 2006 is favourable test setting
Alignment Study	Initial training of interviewers to decrease possible interviewer effects	Despite training of interviewers, high measurement errors are possible due to interviewer effects, operational time constraints, and high amount of data to be processed by decision makers	Ex-post/ex-ante preferences analysis capture one aspect as alignment, 'soft' alignment effects harder to measure. Further studies necessary to increase validity of results	Not assessed due to mixed results

Table 4.2 – Evaluation of Objectivity, Reliability, Validity and Generalisability of MARA 2006 Research Elements (definitions from Easterby-Smith, Thorpe et al., 2002; Homburg and Giering, 1996; Bortz and Döring, 1995; Yin, 1989)

In-depth Interviews (Ex-ante & Ex-post)

The main purpose of the interviews, in particular before the start of MARA 2006, was to create the decision effectiveness dimensions. The Competing Value framework (CVF) transferred to decision effectiveness (McCartt and Rohrbaugh, 1995; 1989) served as a starting point from which to develop dimensions to measure the perceived

effectiveness of decision makers. However, due to the criticisms mentioned in Chapter 3, in particular in relation to the vaguely conceptualised information processing elements, the application of the framework to the effectiveness study was difficult. In contrast to the CVF, which is based on the views of organisational theorists, the following dimensions are based on interviews with practitioners in order to increase practice relevance.

The effectiveness dimensions aim to be applicable to a wide variety of decision contexts, both in the public and private sector. Accordingly, interviews with decision makers from a variety of German blue chip companies as well as some consultancies and public administrations served as building blocks for this research. We therefore applied theory-driven, as opposed to random, sampling (Eisenhardt, 1989). Of the 26 interviewees, 19% were CEOs of Argentinian subsidiaries of German companies, 42.8% were heads or members of the strategy departments or in similar leading positions, 9.5% were consultants. The rest of the interviewees held positions with an interface with strategy development processes. Only one of the interviewees had been in contact with decision analysis approaches before, so almost all could reflect in an unbiased manner on potential evaluation dimensions for strategic decision processes. Table 4.3 displays more detailed information on the interviewees.

Most of the ex-ante interviews lasted between one and two hours, and some up to three hours. As the decision makers' time resources were scarce, in particular at end of MARA, the ex-post interviews were shorter – between 30 and 45 minutes. The interviews were semi-structured. The first part of the ex-ante interview focused on personal concepts of strategy, the second part on current processes of strategy development in the organisation. The third part was the most relevant part to create the effectiveness dimensions. It included a prescriptive focus on how to improve strategy development processes, as well as questions on the impediments to effective strategy development. The ex-post interviews were more directed towards the relation of the STDA applications with the effectiveness dimensions. To avoid an interviewer bias, the questions were open-ended and not directive (Easterby-Smith, Thorpe et al., 2002). Appendix 1 sets out the detailed interview guidelines.

The thirteen interviews conducted according to this structure before the start of MARA 2006 and the thirteen interviews after the completion of the project, served to obtain some information on the reliability of the dimensions. For eight of the shorter

interviews, a thorough interview report was written, whilst the remainder were recorded and transcribed. These documents are the basis for the content analysis, outlined below.

#	Number of interviews	Organisation	Position	Timing
1	1	BASF Argentina	CEO	Ex-ante
2	1	Berlin Senate Government Department for Economics	Head of Department Infrastructure Funding	Ex-post
3	1	Berlin Senate Government Department for Economics	Member of Funding Policy Group	Ex-post
4	1	Berlin Senate Government Department for Economics	Member of Funding Policy Group	Ex-post
5	2	Deutsche Bahn	Head of HR Strategy Department	Ex-ante & Ex-post
6	2	Deutsche Bahn	Head of Business Development	Ex-ante & Ex-post
7	1	Deutsche Bahn	Head of Corporate Marketing Principals	Ex-ante
8	1	Deutsche Bahn	Head of Corporate Strategy	Ex-ante
9	1	Deutsche Bahn	HR Strategy Group Member	Ex-post
10	1	Deutsche Bahn	HR Strategy Group Member	Ex-post
11	1	Deutsche Bahn	HR Strategy Group Member	Ex-post
12	1	Deutsche Bahn	Employment Conditions Group Member	Ex-post
13	1	Deutsche Bahn	Assistant to the Head of Department Employment Conditions	Ex-post
14		Ferdinand-Braun-Institute	Director	Ex-post
15	1	Ferdinand-Braun-Institute	Assistant to the Director	Ex-post
16	1	Roland Berger Strategy Consultants	Former Vice President	Ex-ante
17	1	The Boston Consulting Group	Project Leader	Ex-ante
18	1	Schering Argentina	CEO	Ex-ante
19	1	Schering	Head of Global Project Management	Ex-ante
20	3	Siemens	Former head of Corporate Strategic Planning Department	Ex-ante (2) & Ex-post
21	1	Siemens Argentina	CEO	Ex-ante
22	1	Siemens	Vice President Corporate Strategic Planning	Ex-ante

Table 4.3 – Interview Data of the 26 In-Depth Interviews

Based on the thirteen interviews, which we conducted before the start of MARA, eight decision effectiveness dimensions emerged in the iterative and interactive interview process. When talking about effective strategy development processes, practitioners usually referred to three dimensions: a technical information processing dimension (How

is information processed?), a 'socio' dimension (By whom is information processed?) and a result-oriented dimension:

Technical dimensions:

(1) Transparency and comprehensibility

The extent of transparency and comprehensibility in the process

(2) Rational-based vs. intuitive-based

The contribution of rational analysis and intuitive judgment in the processes

(3) Quality of information exchange

The extent of interactivity and dialogue-orientation in the processes

'Socio' dimensions:

(4) General participation

The extent of participation by people in the organisation in the problem-solving process

(5) Top-down vs. bottom-up

The extent of top-down vs. bottom-up influence in the organisation during the problem-solving processes

(6) Quantity of information exchange

The extent of information exchange between different stakeholders

Result-oriented dimensions:

(7) Creativity

The extent to which the process results in more creativity or more traditional ideas

(8) Strategic insights

The extent to which strategic insights were created through the process

The results of a content analysis (Bortz and Döring, 1995) served to develop these dimensions. Based on some preliminary hypotheses from the literature, outlined in Chapter 2 and 3, and the interview data, we developed a coding system to classify the interview statements. The generation process can be classified as iterative, both data and theory driven (Bortz and Döring, 1995). I stopped with the interview process as soon as 'theoretical saturation' had been reached, i.e. the interviewees began to substantially repeat the information on decision effectiveness (Glaser and Strauss, 1967). The analysis

of the interview results are based on a consensus in the research team as advocated by Bortz and Döring (1995). Due to the large amount of data and the iterative development of the dimensions, we did not calculate an inter-rater reliability. To arrive at largely unambiguous results, we analysed the data together to thoroughly classify the statements according to the coding categories.

We analysed 1,385 sentences from the thirteen ex-ante interviewees, which served as semantic coding units for the analysis (Früh, 2001). As outlined in Table 4.3, we used interview statements, mainly from the third prescriptive interview block on impediments to effective strategies development, in order to develop the decision effectiveness dimensions. Although some of the 'socio' dimensions in particular might partly overlap, interviewee feedback on the results seemed to provide sufficient face validity to use the dimensions, outlined in the following section, for the evaluation study.

	Dimension labels	Mentioned by % of interviewews (out of 13)	Example Citations
Technical Dimensions	The extent of transparency and comprehensibility in the process	8 (61%)	"Strategy development processes need to be comprehensible, homogenous and consistent." "The lack of transparency in strategic planning processes is a common problem." "Strategy development processes need to be designed transparently so that the decision makers can process information accordingly."
	The contribution of rational analysis and intuitive judgment in the processes	4 (31%)	"A problem is how strategy development processes can be designed so that the relevant information from the environment is selected rationally ." "The process encourages some people not to be really objective." "If you invite the right people to the table, the strategy will be more rational."
	The extent of interactivity and dialogue-orientation in the processes (Quality of information exchange)	11 (85%)	"Strategic planning lacks interactive and qualitative discussions - more qualitative interactions are necessary." "Strategy development involves concentration on the essence. It should not be overly bureaucratic." "Strategy development is often based too much on calendars, rather than interaction."
Socio Dimensions	The extent of participation by people in the organisation in the problem-solving process	9 (69%)	"An effective strategy development process includes relevant stakeholders in the organisation. The advantage is a better implementation of the results." "Those who are responsible for executing a strategy need to be involved in the strategy-making process." "As a responsible manager you should have all people involved in strategy development."
	The extent of top-down vs. bottom-up influence in the organization during problem-solving processes	8 (62%)	"Communication from middle management to top-management is essential in strategy development." "In strategy development you need to delegate some power to the bottom." "Effective strategy development results from an iterative processes between top-management expertise and bottom-up knowledge."
	The extent of information exchange between different stakeholders (Quantity of information exchange)	3 (23%)	"It is essential to get information from a variety of sources and to discuss it in strategy development. " "If participants in strategic planning processes don't have all relevant information, you can lose time." "Diversity of opinion is essential in strategy development processes."
Result-oriented Dimensions	The extent to which creativity or more traditional ideas are the result of the process	8 (62%)	"Strategy development processes should stimulate a free exchange of new ideas." "In strategy development, people do not think sufficiently out-of-the box." "Strategy development should be small and creative - guided by people who allow for this."
	The extent of strategic insights created through the process	4 (31%)	"In strategy development people think too operationally - they never get into a helicopter to see the whole picture - everybody who likes strategy leaves." "The focus of strategy development is exeessively on operative things." "In many organisations processes are unfortunately designed so that the things with deadlines push away the things without deadlines - the strategic questions are not considered accordingly."

Table 4.4 – The Interview Statements (ex-ante) Classified According to the Eight Decision Effectiveness Dimensions

The Technical Dimensions

One essential determinant of effective strategy development processes relates to 'technical' information processing. This dimension incorporates the concept of 'procedural rationality', defined as the collection of relevant information and thorough information analysis (Dean and Sharfmann, 1996; 1993).

- The extent of transparency and comprehensibility in the process

  22 out of 99 statements referred to this dimension.

- The extent of rational analysis vs. intuitive judgment in the process

  6 out of 99 statements referred to this dimension

- The extent of interactivity and dialogue-orientation in the processes (Quality of information exchange)
  16 out of 99 statements referred to this dimension.

The 'Socio' Dimensions

Whilst the technical dimension relates to the question of how information is processed, the second essential dimension mirrors the question of who is involved in the process. According to this framework, one should consider the amount and diversity of information included in the processes in order to evaluate the effectiveness of strategic decision processes. The interviewees also recognised the need for a certain degree of participation in strategy development contexts. All of the experts referred to one or several of these aspects on the 'socio' side:

- The extent of participation by people in the organisation in the problem solving process in general
  20 out of 99 statements referred to this dimension.
- The extent of top-down vs. bottom-up influence in the organisation during the problem-solving processes
  16 out of 99 statements referred to this dimension.
- *The extent of information exchange between different stakeholders*
  (Quantity of information exchange)
  9 out of 99 statements referred to this dimension.

The Result-oriented Dimensions

In addition to the six process-related dimensions mentioned above, the interviewees mentioned the following two results-oriented dimensions:

- The extent to which creativity or more traditional ideas are the result of the process
  9 out of 99 statements referred to this dimension.
- The extent of strategic insights created through the process
  Only 4 out of 99 statements referred to this dimension, although the majority of the interviewees mentioned it implicitly.

Evaluation of the Research Quality of the MARA Interviews

As the decision effectiveness dimensions evolved in an iterative and interactive process throughout the interviews, the interviewer inevitably had some limited influence over the interviewees' answers. However, a standardised interview guideline, as outlined above, ensured a high degree of *objectivity* during the interview process (Bortz and Döring, 1995). In addition, we drafted a thorough interview transcript or protocol for each interview. Two researchers conducted the subsequent content analysis to reduce interviewer effects and biased interpretations.

To test the *reliability* of the effectiveness dimensions, we compared the number of times the interviewees mentioned the respective dimensions before and after MARA 2006. Figure 4.8 displays the results. However, as the decision makers asked for short interviews after the time-consuming MARA project, the ex-post interviews only focused on the socio and technical dimensions. Accordingly, Figure 4.8 does not display the result dimensions. Due to the small sample sizes ($N_{ex\text{-}ante}$ = 13 interviewees; $N_{ex\text{-}post}$ = 13 interviewees), 'retest' reliability (Bortz and Döring, 1995) was relatively low (rel_{retest}=.161). However, all interviewees in each of the interview groups mentioned all socio and technical dimensions. The percentage of the statements referring to the dimensions 'Transparency and comprehensability' and 'Participation' was almost equal ($transparency_{ex\text{-}ante}$ = 19%, $transparency_{ex\text{-}post}$ = 18%; $participation_{ex\text{-}ante}$ = 21%, $participation_{ex\text{-}post}$ = 20%). The participation of the ex-post interviewees in MARA 2006, however, probably had some influence on the result. The frequency of top-down vs. bottom-up process, for example, decreased ($top/down_{ex\text{-}ante}$ = 19%, $top/down_{ex\text{-}post}$ =

8%), whilst the number of interview statements referring to rational vs. intuitive aspects, increased (rational/intuitive$_{ex\text{-}ante}$ = 9%, rational/intuitive$_{ex\text{-}post}$ = 20%). We can therefore assume some degree of reliability with respect to the socio and technical dimensions.

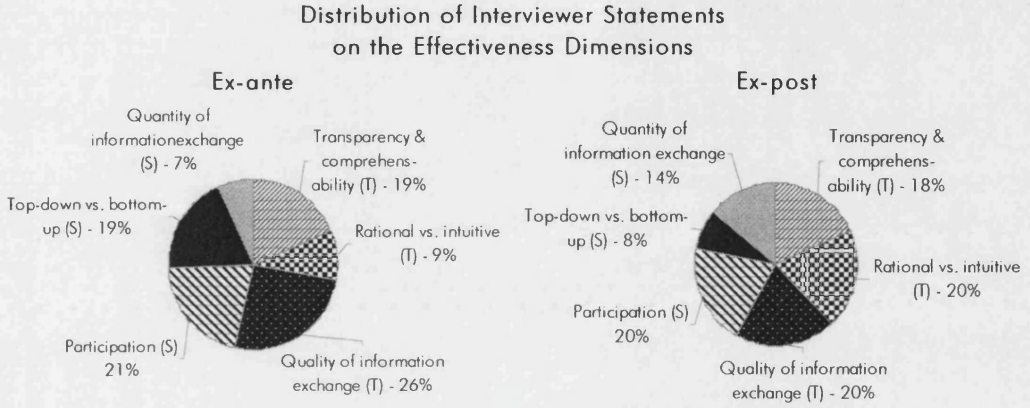

Figure 4.8 – Ex-ante and Ex-post Distribution of Interview References to the Effectiveness Dimensions ($N_{ex\text{-}ante}$ = 43 statements; $N_{ex\text{-}post}$ = 50 statements)

To ensure construct validity, we discussed the interview results with several researchers in the MARA group. This led to consensus on the dimensions, as described above. Due to their positions as decision makers with strategy-related tasks, the interviewees could respond well to the questions asked – although they repeatedly reflected on the concept of strategy itself rather than the process of developing strategies. There is therefore no reason to assume that the interviewees had any incentive to misrepresent their views (Bortz and Döring, 1995).

As outlined above, we selected the interview partners from a wide variety of organisations so that we could subsequently generalise the results to 'resource-based strategic decisions in the public and private sector'. However, as the interviewees were not a random sample of all possible decision makers from both sectors, we have to interpret the results with caution. Nonetheless, the interviewees repeated the effectiveness dimensions substantially ('theoretical saturation' according to Glaser and Strauss, 1967), so we can assume some degree of *generalisability* to the broader domain, as described above.

Case Studies

Six case studies, based on applied decision analysis in strategy development contexts, constitute the core of MARA 2006. The MARA teams generated case studies of comparable methodological scope. They used socio-technical decision analysis in order to help partner organisations solve a strategic problem connected with efficient resource allocation. Remenyi et al. (1998) describes significance, completeness, the consideration of alternative perspectives, the display of sufficient evidence as well as composition in an engaged manner, as general characteristics of 'exemplary' case study research. These five elements are also reflected in the MARA 2006 case study research.

First, the case studies revealed insights into the field of decision analysis, as they contributed to the small body of existing methodological effectiveness literature. In addition, the case studies were of significance to the decision makers in the participating organisations, as they covered pressing resource allocation problems. Second, the research approach included a clear definition of the boundaries of the research problem – an inquiry into the effectiveness of socio-technical decision analysis, in a specific research setting. The research, third, included several perspectives from different stakeholders, in particular through the ex-post interviews to evaluate the effectiveness of the approaches. Fourth, the research used multiple sources of evidence within the framework of the case studies: interviews, observations and modelling, together with an effectiveness survey and an alignment study. Finally, the case studies were composed in an engaged manner, with clearly identified decision makers, who had the opportunity to contribute to the final presentation of the results.

Evaluation of the Research Quality of the MARA Case Studies

With regard to objectivity, we can assume that the MARA teams had some degree of influence on the final case study results. Other teams might have solved some modelling details differently. However, a comparison between initial proposals, which the MARA Steering Committee developed before the start of the projects and the final model results, revealed high consistencies with regard to the model structure in all but one case. With regard to this one case (DB Investment Prioritisation), a complete model structure had not previously been established.

As the case studies are unique settings – with a close relation to a constructivistic research approach – questions of reliability and generalisability are of minor relevance.

Some phenomenologists argue that reliability is not a central issue, as it is difficult to replicate the same research environment (Remenyi, Williams et al., 1998). In order to generate accurate insights into decision processes in the partner organisations (construct validity) with the case studies, we used, as outlined above, several sources of evidence within the case studies. As the research quality indicators are, in particular, relevant for research elements with some positivistic elements, they are somewhat less applicable for the evaluation of the case study results.

Process Effectiveness Survey

Through the larger sample size and the high degree of detachment of the researchers, we can classify surveys in general more on the positivistic side of the research spectrum (Easterby-Smith, Thorpe et al., 2002). The decision effectiveness survey is based on the dimensions developed through the ex-ante interviews and tested with the ex-post interviews. We developed several pre-test versions, which we discussed within the MARA organisational team, and with academics and interviewees. After seven revisions, the final questionnaire could be issued to the decision makers. The primary purpose was to test the perceived effectiveness of STDA, thereby contributing to the small body of knowledge in the area of decision effectiveness evaluation. In this survey, we asked the decision makers to evaluate the existing methodologies for strategic decision making processes in their organisations. A hypothetical ideal state and the evaluation of STDA on these dimensions served as further measurement points. The deviations of MARA from the ideal state versus the deviations of existing processes from the ideal state served as indicators for the effectiveness of STDA. In addition, the author and two other MARA researchers analysed the qualitative statements on strengths and weaknesses and suggestions for improvement. I outline these results, together with the results of the effectiveness study, in the first part of Chapter 6.

Evaluation of the Research Quality of the Process Effectiveness Survey

Within the framework of the MARA research, we can view the effectiveness survey as the most objective, as decision makers received the survey via email with thorough instructions. In addition, the standardised statistical test of the effectiveness assessments resulted in lower exposure to subjective interpretations in contrast, for example, to the interviews.

In light of the high objectivity of the survey and due to the absence of interviewer effects, we can assume low random measurement errors in the survey results. Some measurement errors due to, for example, inattentiveness, might have occurred. The sample size of 44 participants, however, should be sufficiently high to control for 'random noise' in the data. A systematic measurement error in one direction is therefore improbable. In addition, it can be considered highly probable that the participating decision makers truthfully stated their preferences as, for example, we guaranteed the anonymity of their answers.

With regard to validity, it is important to recognise that the survey measured *perceived* effectiveness. The notion of effectiveness is usually connected to a value statement (Campell, 1979). The fact that participants were able to make these value judgments (in stating an ideal point on the scale) can be seen as an indication for the validity of the instrument to measure perceived effectiveness. Due to its international and interdisciplinary 'flavour', the MARA project was in general attractive to the participating organisations. It is therefore possible that the senior decision makers who 'bought' the project, were slightly biased in favour of it. For this reason, a second analysis of the effectiveness survey without the inclusion of the five sponsoring decision makers, as outlined in Chapter 6, served to check the potential biases of these senior decision makers. To check for further biases, we analysed the dependence of the degree of commitment of the decision makers to the project and the perceived effectiveness scores. The results of these 'biases' studies are described in detail in Chapter 6.

As the survey measured only *perceived* effectiveness, we can attribute to the decision effectiveness a slightly lower level of generalisability than 'strong effectiveness' studies (Clemen, 2006), which serve to analyse the relation between the quality of decisions and related consequences. The success of the follow-up projects, organised after MARA 2005 in Argentina, and the requests for follow-up projects after MARA 2006 in Germany, however, indicate that we can generalise the perception of the effectiveness of STDA to non-MARA settings.

Alignment Field Study

In addition to the decision effectiveness aspect outlined above, the integrative model of STDA in strategy development contexts, outlined in Chapter 3 (Figure 3.5), proposed an alignment effect of STDA. We define alignment as the preferences of the participating decision makers 'converging' towards the modelling result. To test this hypothesis, we assessed holistically the preferences of the MARA decision makers towards the options under consideration both before and after the decision conferences. If STDA has an alignment effect, the preferences after the decision conference should be closer to the modelling results than the preferences before the conference. As a second hypothesis, the variance of the preferences might decrease after the modelling, in comparison with the ex-ante assessment. I describe the details of the results in the second part of Chapter 6.

Evaluation of the Research Quality of the Alignment Study

Although we thoroughly trained the team members who elicited the values to obtain a high objectivity of the study, the reliability of the data of this alignment study can be partly questioned. In comparison with other MARA research elements, we can regard the study as the least reliable of the MARA research elements. Due to interviewer effects, operational time constraints, and large amounts of data which decision makers had to process especially in the portfolio cases, we have to assume some measurement errors. This can be one explanation for the somewhat 'noisy' results of this research part, outlined in Chapter 6.

Due to the low reliability, the validity of the study is limited. In addition, converging preferences are only one possible alignment measure. We did not include in the alignment study 'softer' aspects of alignment, such as the degree of common understanding or the degree of common purpose created through STDA (Phillips, 2006), as the interviews already partly covered them. The general results of this research element therefore have to be viewed somewhat critically. However, the case with the lowest modelling complexity, the FBH Appraisal case, resulted in very clear results in favour of the hypotheses. As discussed in Chapter 6, this might be an indicator that the complexity of the portfolio cases posed, in particular, constraints on this research element.

Conclusion

MARA 2006 served as a research framework for this PhD thesis. It provided a unique opportunity to assess the effectiveness of socio-technical decision analysis in an applied setting. This effectiveness focus links to two research objectives of this PhD thesis. First, it served to develop and apply an approach to empirically evaluate the effectiveness of STDA. Second, the research framework provided a possibility to test whether STDA can be applied successfully by a group of young researchers. As a basis for the work on these research objectives, this chapter served to outline the research elements carried out in the framework of MARA 2006:

- The ex-post and ex-ante interviews to develop and evaluate the decision process dimensions
- The decision process effectiveness to test whether the participating decision makers perceived STDA as more effective than existing strategy development processes
- The alignment study to measure group alignment effects

The following chapter outlines in depth the results of the fifth MARA research element – the case studies. The cases are of similar methodological scope and therefore provide the empirical basis for the effectiveness studies outlined in this chapter. In addition, we used them to observe whether a group of well-trained young decision analysts can apply STDA successfully.

Chapter 5 – Case Study Results

5. Case Study Results

You must bake with the flour you have.

Danish Folk Song

The 'flour', which the MARA 2006 partner organisations provided, was plentiful and rich – in particular when compared with MARA 2005. Four project sponsoring organisations from the private and public sectors in Germany offered six projects as ingredients for a successful applied research project. The six MARA case studies, outlined in this chapter, are the result. All cases are 'classical' applications of STDA, based on process consultancy, decision conferencing and multi-criteria decision modelling, as described in Chapter 3. One objective of this chapter is therefore to show that a group of inexperienced young researchers can apply STDA successfully. After a classification of the projects and an overview of the results, this chapter serves to outline the organisational and problem-specific background, the analysis and the specific results of each of the six case studies.

5.1. Overview of the Results

The MARA 2006 case studies set up a comparable set of cases to evaluate the effectiveness of STDA. Five out of six cases included the construction of a portfolio model, including a variety of options and several criteria. In one case, we opted for an appraisal approach to model a large number of criteria and fewer options. Figure 5.1 summarises information on each client organisation, the type of decision problems encountered, the social aspects (Who was involved?), the technical aspects (How were the decision makers technically involved?) and the results of the cases.

In addition to several client specific insights in each case, across-case observations revealed a lack of effective information exchange ('socio' side) and a lack of effective information processing (technical side). On the 'socio' side, in particular in the Deutsche Bahn cases, we observed insufficient lateral communication between departments. Although decision makers worked on similar tasks, they did not realise synergies, and, accordingly, knowledge and experience – often unintentionally – did not circulate effectively. This silo-thinking was in particular evident in the DB case 'Recruiting Channels'. In this case, a decision conference helped to stimulate efficiency comparisons between similar activities in different sub-departments. In addition, in several

organisations, such as the Ferdinand Braun Institut, strict top-down communication from senior management inhibited a free, creative and effective flow of information between the departments.

In all of the cases, we observed, on the technical side, shortcomings in the existing methodologies for the efficient processing of information. In particular, at Deutsche Bahn, many strategic decisions were solely based on subsequently written board proposals. The organisations had not previously introduced a portfolio perspective to process information from a variety of sources. In addition, management teams took many decisions on an intuitive, rather than a structured and thorough, basis. In particular for Deutsche Bahn and the Berlin Senate Government for Economics, the MARA cases served to solve this deficit of structured methodologies to effectively process information and to incorporate a variety of stakeholder opinions.

Classification of the Six MARA 2006 Case Studies

Cases	Client Classification	Type of Problem	Social Aspects (Who was involved?)	Technical Aspects (How were decision makers involved?)	Results
DB AG - Human Resources Strategy in the Context of Demographic Change	Private company, Railway industry	Portfolio decision regarding employability activities to meet challenges of demographic change	Ten members of the HR strategy department, incl. health, qualification and labour relations group	Development of a modelling framework, options and criteria based on interviews; preference assessment for scores and weights; Decision Conferencing	Priority list of 70 activities to increase and maintain employability of existing workforce served as basis for a board proposal
DB AG - Recruiting Channels Optimisation	Private company, Railway industry	Portfolio decision regarding optimal mix of recruiting activities	Nine members of the HR strategy department and of the recruiting groups for students, high school and other pupils	Development of framework, options and criteria based on interviews; preference assessment for scores and weights; Decision Conferencing	Consistent system to appraise 58 recruiting options across departments; exploration of inefficiencies across departments
DB Station & Service AG - Prioritisation of Investments in Railway Stations	Subsidiary of DB AG, Railway industry	Portfolio decision related to optimal investments in railway stations	Twelve decision makers from business development and corporate marketing, incl. the CEO and the board of Station & Service AG	Development of framework, criteria and options with junior decision makers; Decision Conferencing with heads of departments; Final presentation and discussion with CEO	Introduction of a new methodology for strategic investment prioritisation in stations (initial model included 67 options)
FBH - Appraisal of Research Directions	Partly publicly funded research institute	Appraisal problem to identify a promising research direction in a strategically important field	Ten decision makers, incl. the director and the heads of the departments Optoelectronics and Materials	Development of framework, options and criteria based on interviews; preference assessment for scores and weights; Decision Conferencing	Structuring values of the Institute; development of related scales to analyse 13 possible research directions
FBH – Portfolio-based analysis of the research strategy	Partly publicly funded research institute	Portfolio decision related to the allocation of resources across the departments	Ten decision makers, incl. the director and the heads of the departments Microwaves, Optoelectronics, Materials, Processes	Framework developed based on FBH Appraisal project, options and criteria based on interviews; preference assessment for scores and weights; Decision Conferencing with all the major decision makers at FBH	Comparison of resource efficiency of 19 program groups across departments, integration of the appraisal results in the research portfolio
SenWAF - Prioritisation of Infrastructure Funding in Berlin	Local public administration	Appraisal of infrastructure funding projects and subsequent allocation of resources	Ten decision makers, incl. the head of the department Funding Policy	Framework and, in particular, scales development with decision makers; Decision Conferencing	Development of scales to prioritise 39 infrastructure funding proposals; introduction of new methodology to allocate public funds within SenWAF

Table 5.1 – Classification of the MARA 2006 Case Studies

Besides this positive impact to rethinking decision processes on the side of the participating organisations, the case studies revealed some methodological weaknesses. When applying STDA to these cases, for example, clients frequently criticised the 'pure' process consultancy approach (Schein, 1999). A demand for greater involvement in the content of the specific projects was a consistent theme in the feedback for all the MARA

projects. This criticism served as one important input factor for the development of Strategy Conferencing in Chapter 7. In addition, several technical modelling difficulties occurred, for example, in relation to adequate weighting procedures or the inclusion of risk. In Chapter 6, I analyse these weaknesses in more detail.

The following case descriptions firstly focus on the background of the client organisations and the related decision problem. The second part of the descriptions includes the social and technical aspects of the analyses. The final sections describe the results, conclusions and potential shortcomings of the projects. As mentioned in Chapter 4, these case results have to be attributed to the whole group of MARA participants and organisers. I do not claim sole intellectual ownership of the results outlined below. More information on the projects and about MARA 2006 itself can be found at www.projectmara.com.

5.2. Case Study: Deutsche Bahn - Human Resources Strategy in the Context of Demographic Change

Germany, like many other Western countries, is facing a serious problem in relation to demographic change. By 2050, its population is expected to fall by 16%-19% (Eisenmenger, Pötzsch et al., 2006). Large German companies in particular have to respond to this phenomenon. At the beginning of 2006, the German railway company, Deutsche Bahn AG, initiated a project to deal with the threats of demographic change to the employability of their workforce. One of the MARA projects served as a catalyst to advance this project. To my knowledge, this case represents the first application of decision analysis to a topic related to demographic change.

Background Company

In 1994, following the reunification of Germany, the West German railway company, Bundesbahn, and the East German Reichsbahn, merged under the name of Deutsche Bahn AG. At this time, the new company employed approx. 350,000 people (Deutsche Bahn, 2006). The subsequent privatisation of the company led to redundancies – a major reduction in the number of employees was the consequence. In addition, Deutsche Bahn hired only a very limited number of new employees and signed a deal with the unions that they would suspend lay-offs until 2011. As a consequence,

the age structure of the company, outlined in Figure 5.1, will change rapidly over the next decade.

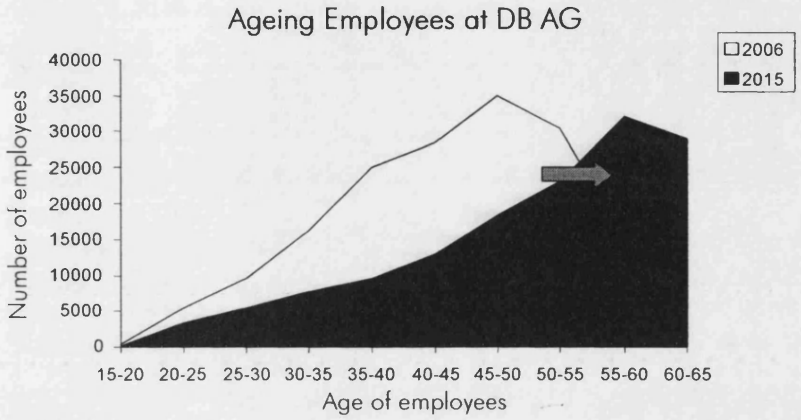

Figure 5.1 – Change of Employee Structure at DB AG (from Deutsche Bahn, 2006)

In addition to the problems the company faces due to an ageing workforce, DB is currently in a transition phase from a state-owned monopolist to an international logistic company. This change increases the need for a highly trained and motivated workforce.

Background Decision Problem

In the context outlined above, one of the MARA 2006 teams aided the HR strategy department to proactively evaluate activities to maintain and increase the employability of the existing workforce. The DB team defined employability as capability and willingness to deliver high quality work and the willingness and ability to acquire new skills in order to deliver high quality work. Accordingly, the objectives of the project were threefold:

- to facilitate an effective information exchange between participating HR sub-departments in order to create a common understanding of the topic
- to develop an efficient portfolio of diversified activities to respond to the challenges of demographic change as effectively as possible
- to provide sound argumentation, including a suggested budget, for a board proposal

The Analysis

The HR strategy department sponsored the MARA project within the framework of the initiative 'Demographic Change'. On the 'socio' side, three sub-departments participated in the project: the health group, the qualification group, and the labour relations department. The health group focuses on keeping employees healthy, so that they can perform their professional duties effectively. The qualification group is responsible for the training and the promotion of employees. In the context of the project 'Demographic Change', the labour relations department was responsible for checking the compatibility of all the employability activities with operational constraints, such as legal restrictions and potential union objections.

Due to the pilot study character of the project and time constraints during MARA 2006, the analysis focused on three target groups: maintenance (electricians, locksmiths and electrical engineers), train drivers and 'Rangierer' (workers, who are moving wagons and trains in stations – 'shunters'). These groups account for approx. 40,000 employees within DB. The structure of the portfolio model, displayed in Figure 5.2, reflects these three groups within the areas Qualification, Health, and Labour Relations.

Figure 5.2 – The Portfolio Model of the MARA 2006 Project 'Demographic Change'

Each box in Figure 5.2 reflects one option to maintain or increase the level of employability for one or several of the three target groups. An example of an option in the qualification area was an internet platform for all employees to provide information on internal qualification programmes. A campaign for more sports activities targeted at

a specific employee group was an example for the health option. The labour relations options included, for example, shifts in regular working time based on the age of the employees. To consistently evaluate these different options, the decision makers developed criteria, which could be applied to each of the three areas, Qualification, Health and Labour Relations. These included the expected financial costs and several benefit criteria outlined in Table 5.2.

Benefit criteria	Description
Ability	The extent to which an option maintains or improves employees` capability to perform their jobs and prepares them for future positions. It includes taking care of physical and psychological fitness, as well as empowering employees to develop additional skills. Moreover, it requires the workforce to sustain their learning potential.
Motivation	The extent to which an option improves employees´ work satisfaction and increases their commitment to Deutsche Bahn. First, it includes improving working conditions. Second, it includes employees' willingness to change by keeping employees informed of their roles, the evolution of their roles and open opportunities.
Self Responsibility	The extent to which an option promotes employees´ personal responsibility. It implies a sustainable behavioural change towards a healthy lifestyle and employees' own initiative to develop additional skills.
Long term impact	The extent to which an option generates added value (has a positive impact on Ability, Motivation, Self-responsibility) or decreases costs beyond the five year time frame or both.
Enforceability	The likelihood that an option will be implemented. This takes into account legal restrictions, obstacles posed by union treaties and work council regulations.
Cost Criterion	
Financial Costs	The extent to which an option creates overall monetary costs, including the implementation and running costs during the 5 year time frame.

Table 5.2 – The Cost and Benefit Criteria of the MARA 2006 Project 'Demographic Change' (from Beer, Evrard et al., 2006, p.9/10)

For the assessment of these scales, different groups of project participants scored each option on all the criteria using 0 to 100 relative scales. To ensure high quality expert judgments, we encouraged the decision makers to further break down the scoring process by assessing, first, the impact of each option per employee on the criteria and, second, the number of employees that each option would address over the five-year time frame. Both assessments entered in the final scores. For the enforceability criterion, the decision makers stated their estimates of the probability with which they could successfully implement an option within a five-year time frame. Using a proper scoring rule, we transferred these probability judgments into penalty scores and normalised them to a 0-100 relative scale. After the assessment of the weight of one criterion in relation to the different areas (within criteria weights), we then assessed the weights of the criteria in relation to each other (across criteria weights), as described by Phillips and Bana e Costa (2007).

The Results

The analysis resulted in an order of priority list for the employability options based on benefit/cost ratios of the options. The cumulative cost and corresponding benefit values of all possible portfolio combinations are depicted in the grey area in Figure 5.3. Along the efficiency frontier on the upper side of this graph, the black dots present the most efficient combinations of employability options. Of particular interest to the HR strategy department was the point where the efficiency curve had a sharp bend, reflecting a significant decrease in the marginal benefit of the options to the right.

A Variety of Smaller Projects Result in Favourable Cost/Benefit Ratios

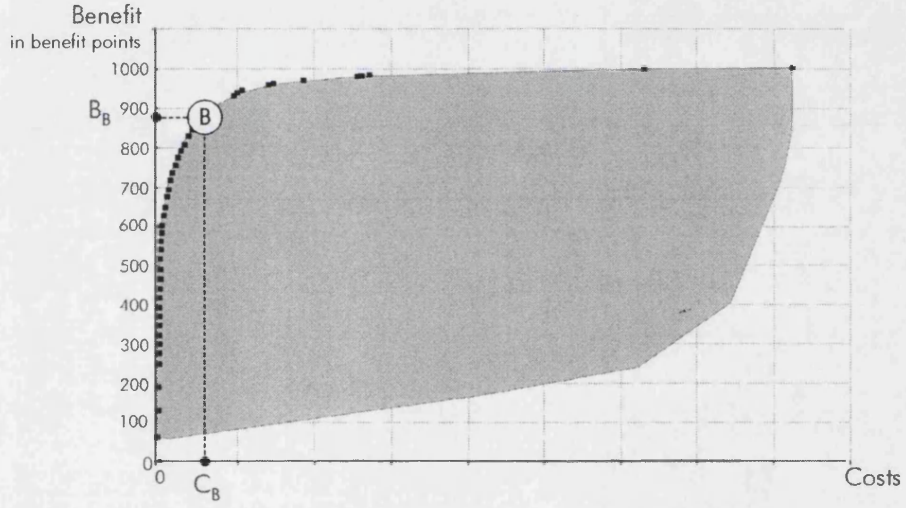

Figure 5.3 – The 'Envelope' of the MARA 2006 Project 'Demographic Change'

The analysis, outlined above, provided the HR Strategy Department with a sound evaluation of possible employability options with which to face the organisation´s demographic change. STDA thereby provided an effective exchange of knowledge between the participating HR sub-departments. Based on the results of the ex-post interviews, described in Chapter 6, the analysis seems to have fostered a common understanding of the topic. The quantitative analysis aided the HR Strategy Department to address the main trade-offs in facing the negative effects of demographic change. In addition, the results served to create a proposal which the corporate board of Deutsche Bahn AG discussed at the beginning of the year 2007.

One potential weakness of the analysis is that projects with very different costs were included in the analysis. This wide range of costs may have somewhat distorted the

benefit assessments of the decision makers, as it is usually difficult to compare projects with a very different magnitude of impact. One indicator of the effect of this assessment difficulty might be the cluster of cheap projects at the beginning of the efficiency curve, as depicted in Figure 5.3. One the other hand, we can view these smaller projects as 'low hanging fruits', which should be carried out first. To facilitate an improved ease of data processing, it would have been possible to model very costly options in a separate area.

The DB Project on demographic change won – together with the SenWAF project – the MARA 2006 Excellence Award. The project results were presented at the Annual Meeting of INFORMS 2006, which took place in November 2006 in Pittsburgh.

5.3. Case Study: Deutsche Bahn – Recruiting Channels Optimisation

Besides the topic of demographic change, the HR department of Deutsche Bahn was concerned with another pressing problem. By virtue of its history as a railway monopolist in Germany with a reputation for an unpunctual and unfriendly service, the company was facing a problem of comparably low employer image leading to difficulties in attracting quality candidates for positions in the company. In this context, a second MARA team assisted the HR department in optimising the 'recruiting channel mix' of the recruiting department.

Background Organisation

Although a well-known brand in 2006, Deutsche Bahn was still placed by (business) graduate students in the lowest third of a list of the top 100 German employers (Trendence, 2006). Its weak employer image on the one hand, and its ageing workforce, on the other hand, make the recruitment of sufficiently well qualified staff a particular challenge for DB. As this development affects mostly technical professions with physically highly demanding tasks, the MARA project 'Recruiting Channels' focused on recruiting activities to attract blue collar workers and engineers.

Background Decision

The evaluation of the effectiveness of the recruitment activities for these employee groups is a particular challenge, as the potential future benefits of the programs are uncertain and relate to multiple dimensions. As the timeframe of MARA 2006 was comparatively short, the MARA and the DB teams limited the focus of the pilot projects to the following three major target groups:

- university students, with engineering focus and leadership potential,
- high school graduates with a technical background, and
- 'other pupils' without a high school degree who might qualify for one of the DB apprenticeship programs.

Focusing on these three groups, the project aimed, first, to assess the value-for-money ratio of different recruiting activities for several target groups. Second, to generate a consistent portfolio-based evaluation system for current and future recruiting activities. This analysis, finally, aimed to provide a methodological basis on which to explore synergies between different HR sub-departments.

The Analysis

The head of the HR strategy department, together with the heads of the three sub-units and several other employees from the HR department, took part in the analysis of university student and pupil recruiting activities. In an iterative process, this group constructed evaluation criteria, which served to assess each recruiting option. These included on the benefit side: the extent to which the option creates a high number of high quality applications, the extent to which the option contributes to a positive impact on employer image, the degree to which it is effective in the long-term, and the degree to which it has a spill-over effect on recruitment outside the target groups (Schunter, Karatzaferi et al., 2006). The cost criterion related to the money spent for the implementation of a specific recruiting activity, as well as the incurred internal personnel cost. Participants estimated the cost values as the annual salary of persons typically involved in the specific recruitment under consideration, divided by the number of

annual working days to carry out the activity (Schunter, Karatzaferi et al., 2006). Figure 5.4 displays the corresponding value tree.

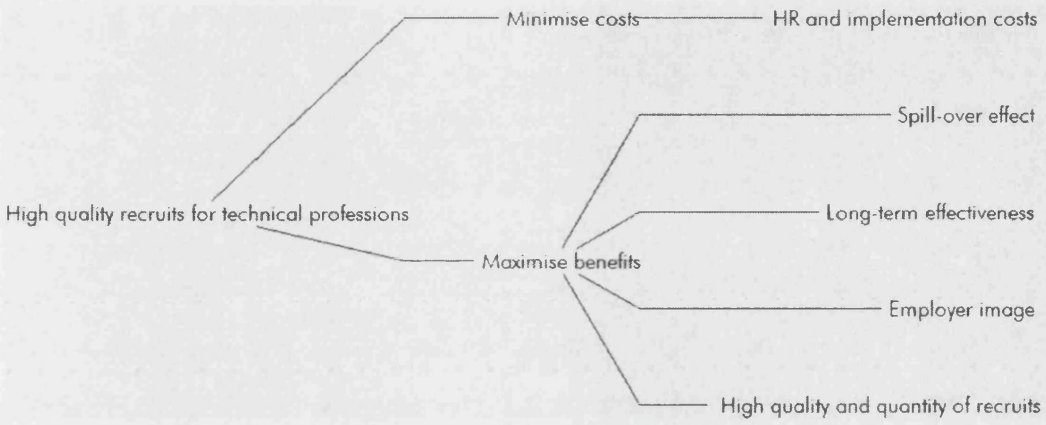

Figure 5.4 – The Criteria Tree for MARA 2006 Case 'Recruiting Channels'

The model itself consisted of 58 past, current and future recruiting options, distributed across the three target groups. In addition, one area integrated all activities which affected more than one target group. Within each target group, a set of options referred to media activities, such as online postings of job descriptions, to co-operation activities, such as participation in a job fair organised by external providers and to personal contact with DB staff ('Experience DB'), respectively. Figure 5.5 displays the model structure for the DB 'Recruiting Channel' case.

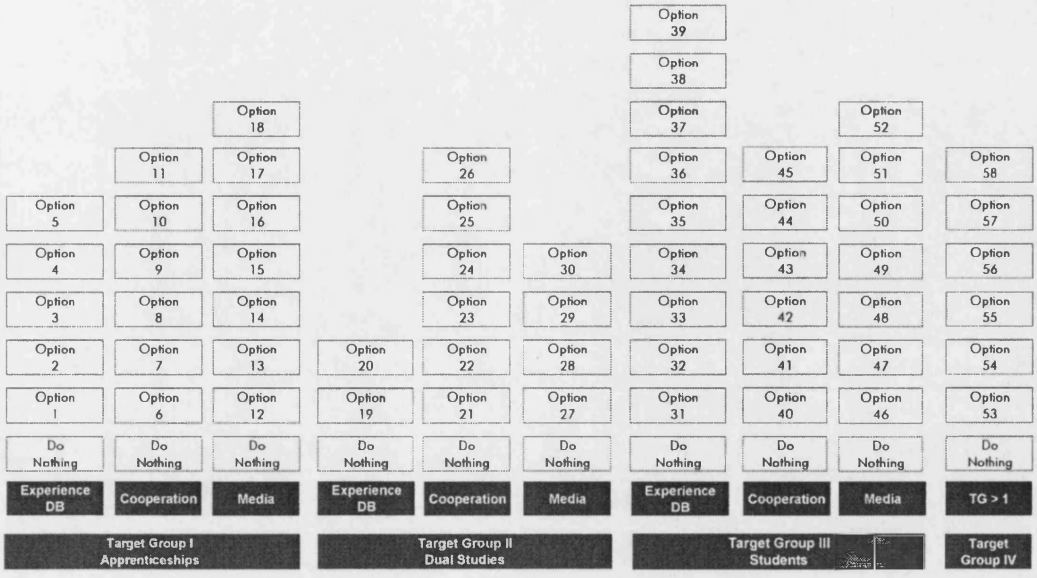

Figure 5.5 – The Model Structure for the MARA 2006 Case 'Recruiting Channels'

The Results

After several decision conferencing sessions during which the decision makers scored the options and assessed weights, the final model resulted in a priority list of recruitment activities, based on the ratio of recruiting costs and overall recruiting benefits. This 'recruiting value-for-money' figure for each option provided the DB HR department with a transparent indicator with which to compare different options across target groups and departments. In particular, the differences in efficiencies stimulated an effective transfer of knowledge and discussion between the recruiting departments in order to explore and realise synergies within the HR department.

Analysing the current resource spending of the HR department resulted in the envelope depicted in Figure 5.6. The point 'P' (proposed) depicts the cost and benefit values of the current portfolio of recruitment activities. Based on the decision model, the portfolio ('B' – better) could be identified, which would lead to more benefit points (+35%) with a only slight increase in costs (+6%). An alternative portfolio ('C' - cheaper) would lead to approximately 50% of the costs yielding approximately the same benefits (99%). This analysis resulted in insights for the creation of efficient recruiting portfolios in the future.

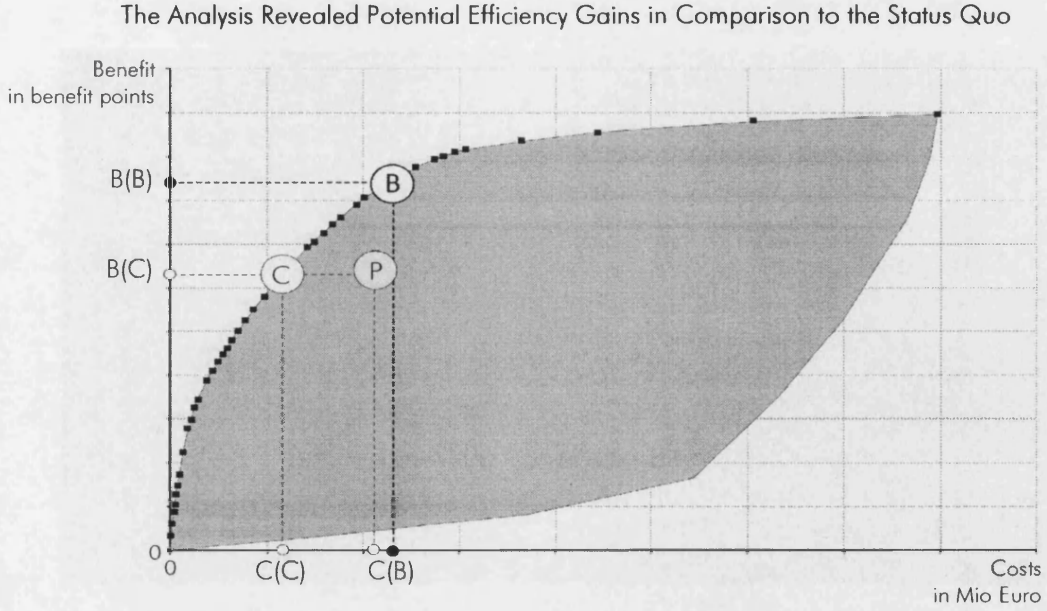

Figure 5.6 – The 'Envelope' of the MARA 2006 Case 'Recruiting Channels' (P – current investment; B – better allocation; C – cheaper allocation)

Similar to the DB project 'Demographic Change', the decision analysis provided the HR department with a transparent and comprehensible foundation on which their decision could be based. One weak point of this analysis, however, is the rather imprecisely defined criterion, 'Quality and quantity of recruits'. Decision makers assessed this criterion on a 0 to 100 relative scale. It would have been possible to use a constructed numerical scale as described by Bana e Costa and Beinat (2005) and as used in the SenWAF case. Due to initial difficulties in framing, this could not be done within the timeframe of MARA 2006. Nonetheless, at the end of the project, the head of the HR strategy department expressed his intention to integrate a simplified version of the approach in the decision processes of his unit.

5.4. Case Study: DB Station and Service – Market-oriented Prioritisation of Investments in Railway Stations

Deutsche Bahn Station & Service AG, a subsidiary of Deutsche Bahn AG, hired the third project team in the context of MARA 2006. As the project included investment options which added up to a volume of approximately 800 million euros, this project had the largest financial scope of all MARA 2006 projects.

Background Organisation

DB Station & Service owns and manages approximately 5,400 stations across Germany. The three business units, Services, Operations and Rental, provide services for travellers, train operators and shop tenants. The company administers, operates and develops the travel chain from the forecourt to the platform, as outlined in Figure 5.7 (Schäfer, Etchart et al., 2006). DB Station & Service thereby derives its main revenues from shop tenants and the stopping fees of train operators.

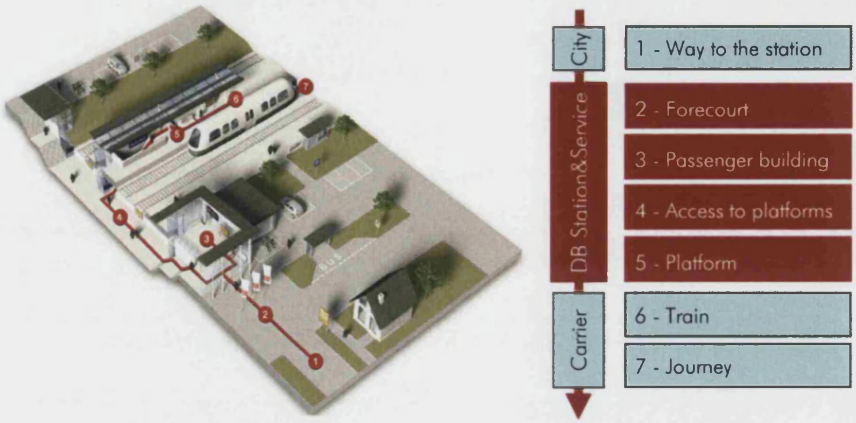

Figure 5.7 – The Travel Chain, Managed by DB Station & Service AG (from Schäfer, Etchart et al., 2006)

Background Decision

As the travel chain affects several stakeholders such as the DB holding, public authorities, travellers and shop tenants, investment decisions are particularly challenging for DB Station & Service. Multiple stakeholder views often conflict and, as some investments bind assets irreversibly for decades, a high degree of uncertainty has to be taken into account. According to Phillips and Bana e Costa (2007), there are three approaches to tackling resource allocation decisions. One approach is based on corporate finance techniques, quantifying costs and benefits, for example, by using Net Present Value calculations. The other approach is related to operations research models, which aim to maximise investment benefits so that the budget constraint is not exceeded (Hillier and Lieberman, 2005). The third approach is related to decision analysis, either in the form of decision trees or based on multiple-criteria decision analysis. The latter has the advantage of being able to quantify 'soft' strategic criteria, in addition to the more financially driven criteria.

The objective of the project was to generate strategic insights into an efficient allocation of strategic investments in stations. In particular, the model had to incorporate multiple stakeholder views, based on financial and strategic criteria. Two middle managers from business development and corporate marketing sponsored the project. Subsequently, the number of participants grew to 12 decision makers, including one board member. We presented the final results to the CEO and the board.

The Analysis

To fit the project into the limited timeframe of MARA 2006, the client had chosen a specific regional focus. As the possible investment options in this region exceeded 300, we developed a system with which to cluster the investments. The options thereby referred to:

- the station size, which we classified by the client's internal standards (Category 1: very large to Category 6: very small),
- the 'field of action' for the specific investment, which included investments in travel facilities at the platform, travel facilities in the building, customer information, service quality and appearance as well as 'inter-modality'[2],
- number of stations considered and
- the magnitude of improvement.

Figure 5.8 below depicts one investment option. It refers to an investment in 27 stations of the Category 4. In this case, an internal DB study rated 21 of these stations with 'yellow' and six with 'red' in relation to the quality level of the facilities of the station. In addition, the gap analysis indicated a 'red' status in relation to barrier-free access at 25 of these stations. The option would now be to turn all 'red' and 'yellow' ratings into a green rating in relation to facility quality and barrier-free access. Each option also depicts necessary improvements and possible measures to increase the respective quality levels. The final model, which served as a discussion basis with the CEO, included 67 of these options.

[2] 'Inter-modality' refers to activities which enhance the mobility from one traffic net to another, e.g. rail and car.

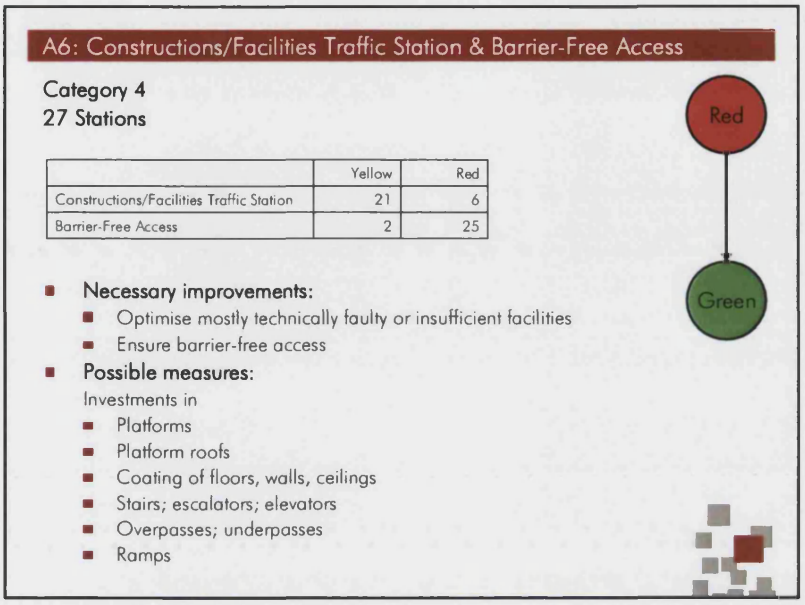

Figure 5.8 – An Example for an Investment Option

The evaluation criteria for the investment options reflected the different stakeholder views. On the benefit side, the decision makers assessed the extent to which the options enhanced shop tenants and customers' satisfaction, the extent to which they strengthened the DB holding and the degree to which they maximised a positive image of the DB. 'Sustainable growth' served as a financial criterion, which the DB team assessed as expected profits or expected reduction in operational costs. Finally, we used the financial costs of the investment in a timeframe of five years as the cost criterion.

The Results

As a result of the project, DB Station & Service obtained a transparent prioritisation of strategic investments according to investment efficiency. Figure 5.9 below depicts the current investment spending of DB Station & Service with an 'S'. If the company increased their spending by 5% to the 'better' portfolio 'B', a 72% increase in benefit could be achieved.

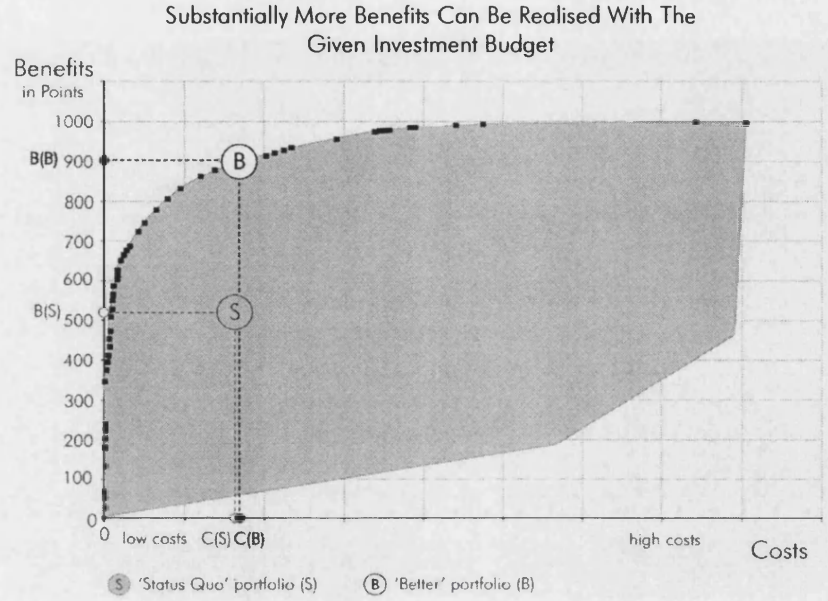

Figure 5.9 – The 'Envelope' of the DB Investment Prioritisation Case

The reasons for this increase in efficiency are rooted in the higher investment efficiency of larger stations and certain fields of action. Figure 5.10 depicts the resource efficiency, measured by the cost/benefit ratio. A bigger bubble symbolises a higher (improved) investment efficiency. As displayed in the right column and the top row, investments in Category 1 and Category 2 are on average the most efficient. The same accounts for investments in the Field of Action 3 and Field of Action 4. Legal requirements for security investments in stations, however, constrain these results. Due to these restrictions, DB Station & Service currently has to invest most of its resources in the first two fields of action. This is why, during the decision conference, the CEO proposed that investments in the first two and the last fields of action be fixed and not be changed in the medium term.

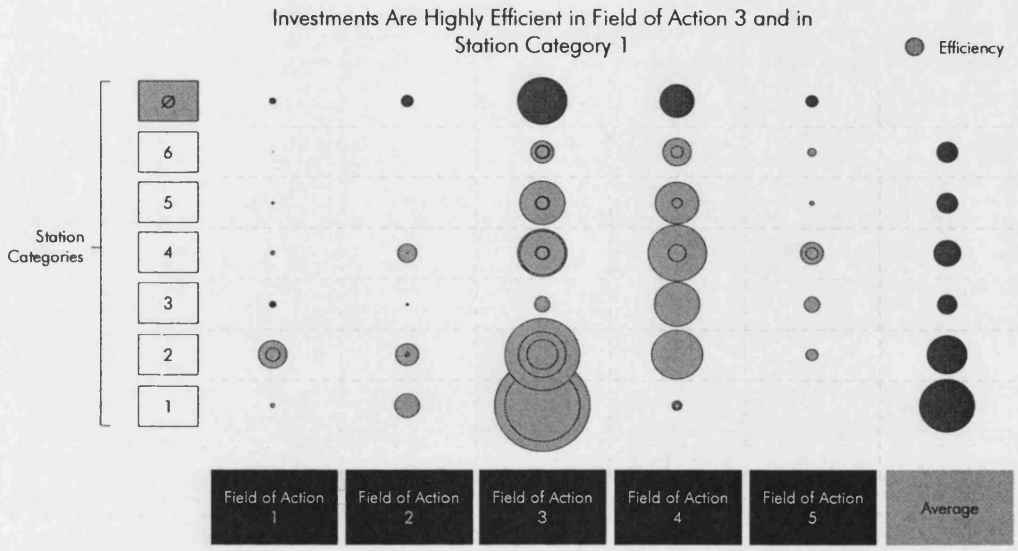

Figure 5.10 – Investment Efficiency in DB Station Across Fields of Action and Station Categories

In addition to these clear insights into losses of investment efficiency due to external constraints and a new way to compare different investments comprehensively, the case of DB Station & Service revealed significant decision process innovations. At that time, the company had been making decisions based on single board proposals. The MARA case represented the first attempt to turn such 'proposal-based' decision making into a portfolio perspective. As an indicator of the perceived usefulness of the approach, at the end of the project, the strategy department of the holding was interested in adopting the approach more widely throughout the company.

The somewhat complex 'strategic option' design, outlined above, was one core weakness of the analysis. The creation of options based on multiple dimensions led to difficulties for the decision makers in assessing relevant data. We should therefore judge the quality of the input data to the model as comparatively low. On the other hand, this did not reduce the decision innovation stimulation effect of the MARA project. According to the interviews conducted after the completion of the project, DB Station & Service used the MARA results to re-design some decision processes between middle management and board level.

5.5. Case Study: Ferdinand Braun Institute für Höchstfrequenztechnik – Appraisal of Research Directions

The research institute 'Ferdinand Braun Institut für Höchstfrequenztechnik' (FBH) provided two projects for one of the MARA 2006 teams. The first project (Phase I) focused on an appraisal of research directions in a new, strategically important research field. The objective of the second project (Phase II) was to embed these results in the overall research portfolio across the institute. Due to the time constraints of MARA 2006, the team only ran a short pilot study as a second part of the project. I outline both cases below.

Background Organisation

The FBH is a publicly funded research centre in the areas of microwave technology and optoelectronics. It produces high-end lasers, circuits for communication and sensor technology. In order to bridge the gap between applied research and the market, the FBH aims to develop new technologies and create spin-offs in order to transfer new products onto the market. Due to its successful activities over the last few years, the FBH won the 'selected innovative location' prize in the competition 'Germany: Land of Ideas' funded by the Federal Ministry of Education and Research of Germany.

Background Decision

Due to technical progress in their field of research, the institute had to decide on the best way forward regarding potential research strategies in the field of GaN-based optoelectronics. This decision is of particular importance for the future of the FBH as it will commit a substantial amount of resources to this field over the next few years. Due to the technical complexities involved and uncertain business opportunities, the director of the institute hired a MARA team to assist in the appraisal of the potential research directions outlined in Figure 5.11. These research options consisted of different coloured laser fields with a variety of different applications. The institute follows both commercial and scientific objectives, which needed to be balanced for the appraisal decision to find the best way forward for the institute as a whole. In addition to the director and his assistant, eight other researchers formed part of the project team on the FBH side, including the head of the 'Explorative Technologies' department, whose research investigates promising new technologies for the institute.

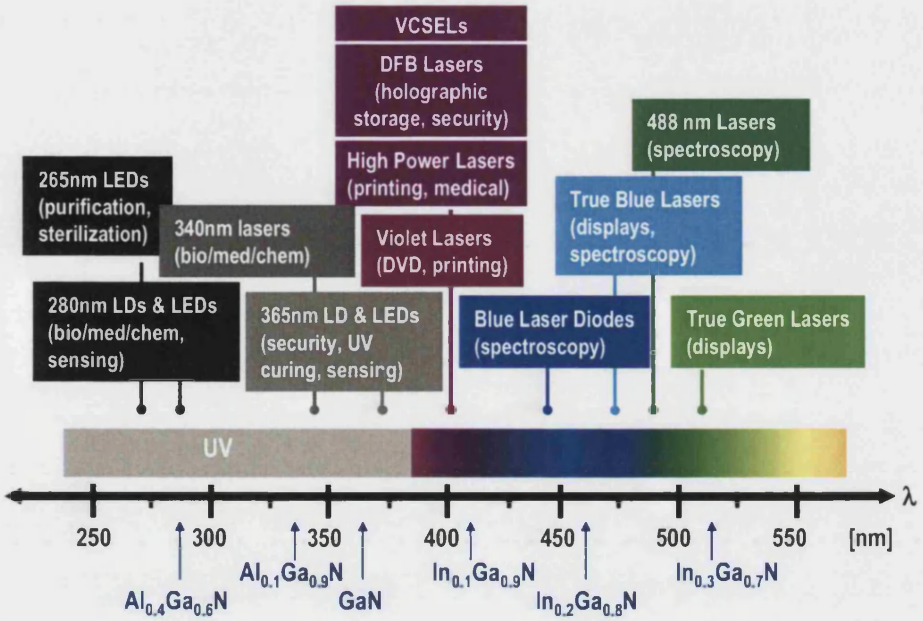

Figure 5.11 – Potential Research Directions for the FBH in GaN-based Optoelectronics

The Analysis

In contrast to the other MARA cases, outlined above, the FBH MARA team developed in the first phase of the project, an appraisal model to incorporate a limited number of options and a greater variety of criteria. To map the scientific and commercial criteria adequately, the team had to take a variety of aspects into account. In an iterative approach, the team and the researchers used these insights to construct the criteria structure, as displayed in Figure 5.12.

Due to its character as a research institute, the FBH is concerned with scientific leadership when selecting research directions. This includes the extent to which a research direction contributes to the scientific reputation (measured in potential PhD theses and papers), the extent to which the option provides a basis for future technological developments, the probability of which the option increases access to potential research partners, the degree of scientific competition when pursuing the research direction and the potential to create more jobs in the institute as well as use existing knowledge effectively. On the commercial side, three criteria served to assess the options: the probability of creating spin-offs with the respective research direction, the availability of industry partners and the estimated market size. Expected private and public funding, as well as the costs associated with the research directions, also

influenced the final decision. We conducted the analysis with a timeframe of three years, using 0 to 100 relative scales for the benefit criteria (Oelze, La-Ornual et al., 2006).

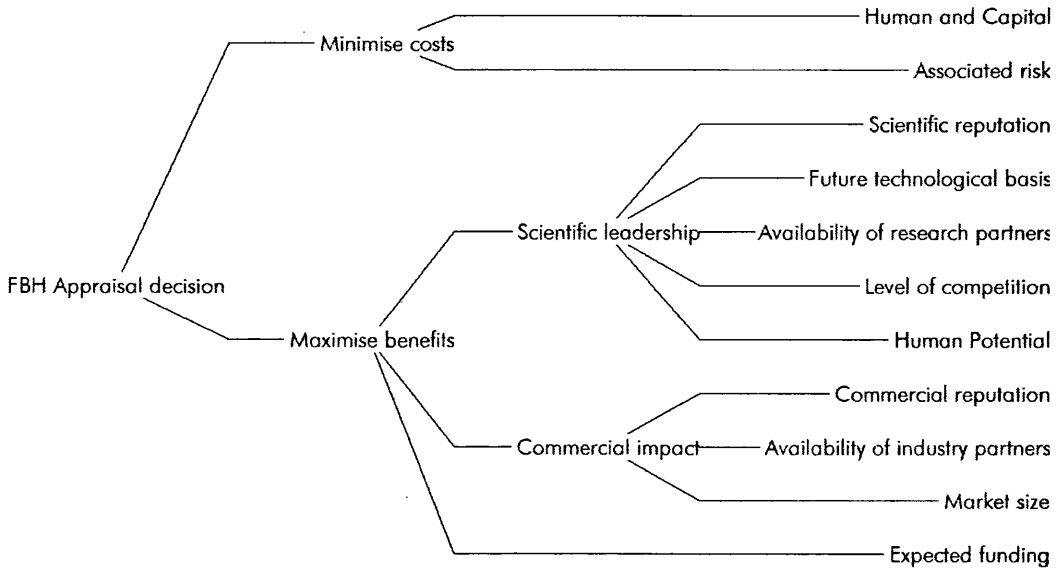

Figure 5.12 – Criteria for the Appraisal of Research Directions at FBH

The Results

After scoring and weighting the options and criteria, the model result pointed to five dominant research directions. Figure 5.13 depicts these five options at the frontier to the north-east. The costs are thereby plotted as 'preference for costs' with '100' as the cheapest options. When using the weights assessed by the FBH team, Option 6 and Option 12 emerged as the most promising options. Figure 5.14 summarises the specific contributions of the individual criteria to the overall result. Extensive sensitivity analysis at the end of the project confirmed the robustness of these two projects as the most favourable options. The evaluation interviews after the completion of MARA 2006 revealed that FBH is indeed now pursuing these two research directions.

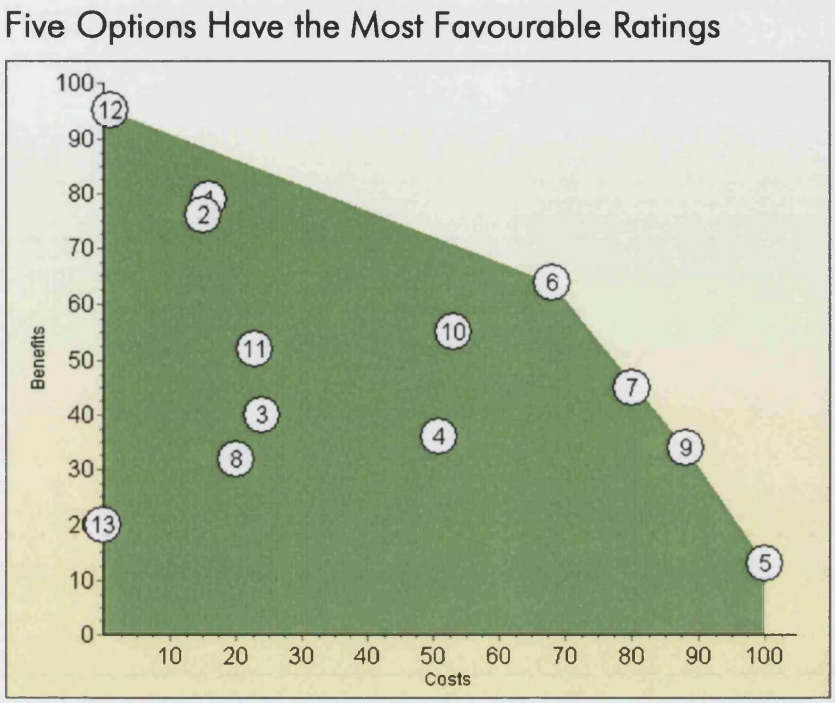

Figure 5.13 – Cost/Benefit Plot of Potential Research Directions in GaN-based Optoelectronics (high figure on the cost axis relate to low costs – 'preference for costs')

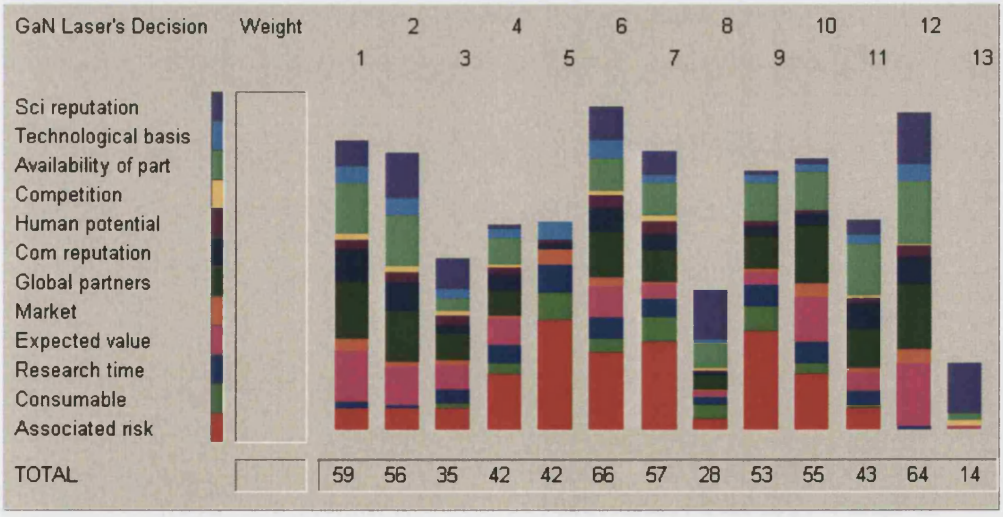

Figure 5.14 – Criteria Contribution of the Potential Research Directions in GaN-based Optoelectronics

During the course of the project, the director of the institute pointed to one possible weakness of the analysis: the lack of a requisite structure for the decision tree (Phillips, 1984). It is highly probable that the FBH team could have taken the same decision with fewer criteria than used in this project. In addition, the quality of the analysis could have been improved by using more natural scales, such as the number of potential publications generated, instead of more simple 0 to 100 relative scales.

Despite these shortcomings, the project for FBH was nominated as one of the five finalists for the INFORMS DAS Practice Award 2006.

5.6. Case Study: Ferdinand Braun Institut für Höchstfrequenztechnik – Portfolio-based Analysis of the Research Strategy

Following the completion of the appraisal phase of the FBH case, our initial idea was to embed the results in a portfolio analysis of the research activities for the whole institute. However, due to the short time frame of ten weeks, we could only partly complete this sub-project. The results of this project therefore have to be viewed as less valid in comparison to the other MARA 2006 cases.

Background

GaN-based Optoelectronics is one project group within the FBH department 'Explorative Technologies'. In addition to this 'incubator department', the institute consists of three other departments: Microwaves, Optoelectronics and Basic Technologies. Across these departments, the institute created 21 research project groups, each with several sub-projects. The core idea of the following portfolio analysis was to assess the costs and benefits of each of these research groups, including the selected research directions in GaN-based Optoelectronics. The participating group of decision makers included the director of the institute and his assistant, the heads of the 'Explorative Technology', Microwaves, Optoelectronics and Basic Technologies departments and two other researchers.

The Analysis

We conducted the portfolio analysis from a more strategic point of view than in the appraisal case. Three top-level criteria from Phase I and the strategic criterion 'Potential future value', as shown in Figure 5.15, served as evaluation criteria for the research portfolio.

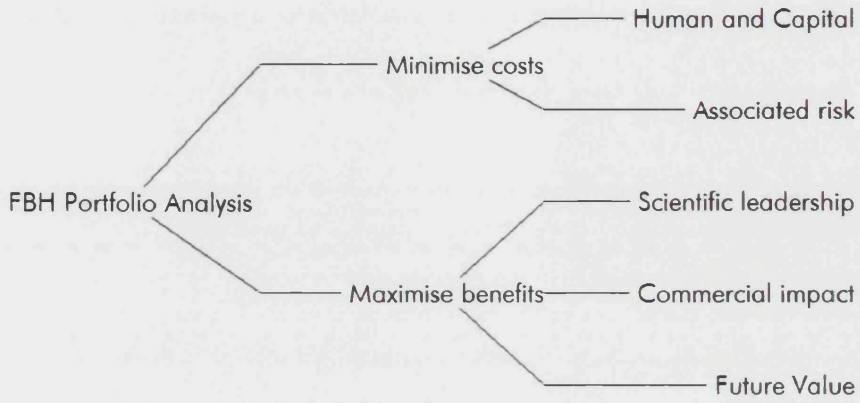

Figure 5.15 – Criteria for the Portfolio Analysis at FBH

Again 0 to 100 relative scales served to capture the decision makers' assessments of the research projects according to these criteria. Figure 5.16 depicts the 21 project groups, which we analysed with these criteria.

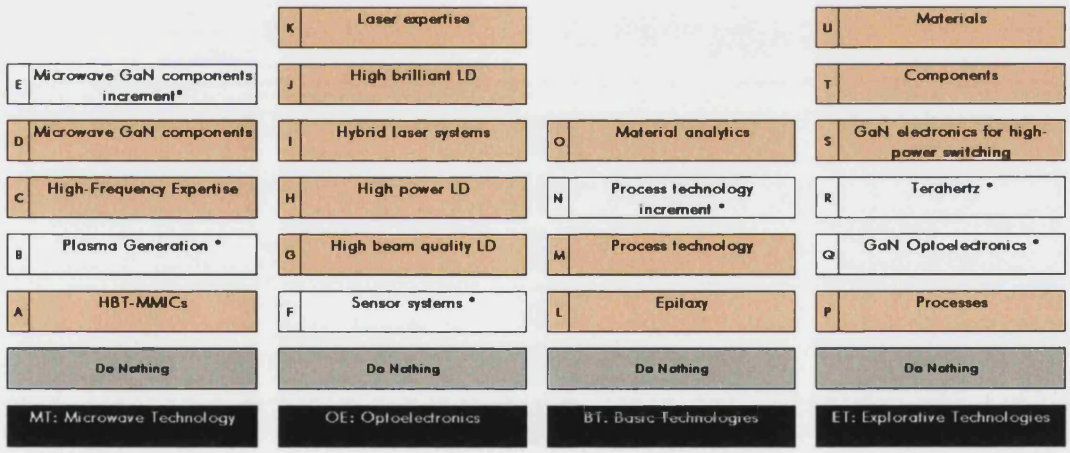

Figure 5.16 – The Model Structure for the FBH Portfolio Case

The Results

The Institute's staff used the analysis above as a basis for information exchange between the departments. During the decision conference, the FBH team discussed strategic questions regarding several research project groups using the model as a 'communication catalyst'. In particular, we analysed several extensions of existing research projects, shown in white in Figure 5.16. None of these research projects scored well in relation to benefit/cost ratio. FBH staff therefore decided not to expand the existing activities. Surprisingly, several basic technologies, which are necessary for the Institute's work, also resulted in low resource efficiency. However, we can probably not

easily compare the area, 'Basic Technologies', as an area which provides basic services for the other departments, with the other research projects. The decision makers therefore decided to exclude it from the final analysis.

One particular weakness of this case was the fact that a relatively inexperienced MARA facilitator was not fully able to create an atmosphere of free expression of opinion during the decision conference. A tendency towards command-based, top-down decision making from senior management became obvious during the decision conference and a reduction in the value of the results was the consequence. The low quality of input data from the decision makers can be viewed as a third weakness. As the FBH team had already committed many man hours in the appraisal phase, they were reluctant to invest a substantial amount of time in the portfolio analysis. The core objective of the project therefore was more to test the portfolio analytic approach than to derive valuable strategic insights. We therefore have to interpret the results of this case with special care.

5.7. Case Study: Berlin Senate Government Department for Economics – Prioritisation of Infrastructure Funding in Berlin

As the only MARA 2006 project in the public sector, one of the MARA teams assisted the Berlin Senate Government Department for Economics to efficiently allocate funding resources in the area of infrastructure funding policy. In the following sections, I outline the approach and the results of this project.

Background Organisation

The Berlin Senate Government Department for Economics (SenWAF) is responsible for the funding program 'Common Task of Improving Regional Structures' – a federal initiative to support economically weaker regions. The objective of this investment-related program is to create additional income and jobs for a variety of regions in Germany. Berlin is eligible to participate in this program as its per capita income and investments are comparatively low. The program provides funds for business-related infrastructure projects. Beneficiaries are mainly public administrations on the district level in Berlin and public-private partnerships. Due to sufficient available funds, the SenWAF has been able to accept all funding proposals over the past few years. However, as the budget

decreased in 2006 and the number of funding proposals increased, the SenWAF, for the first time, had to prioritise incoming funding proposals and select only a few of them. To assist with this task, the SenWAF hired a MARA 2006 team.

Background Decision

The head of the department funding policy, three 'strategic decision makers', who had a broader view of the resource allocation process and six employees, who worked directly on the assessment of the funding proposals, participated in a decision analysis to prioritise funding proposals. The project aimed to develop a transparent evaluation system to efficiently prioritise public funds in the area of infrastructure. We asked the participants to evaluate funding proposals based on benefit and cost criteria. The objective was to enable the SenWAF to determine the 'public value-for-money' for individual infrastructure funding proposals. As a final result of the project, the SenWAF asked for a coherent system, which it could transfer to other resource allocation contexts within the organisation.

The Analysis

In comparison with the other projects, the development of scales was of particular importance in the SenWAF project. We invested approximately half of the total project time in thoroughly developing an appropriate framework for the criteria and related indicators. As a starting point, the SenWAF and MARA teams developed an objectives hierarchy, based on Keeney's (1992) value-focused thinking approach. Subsequently, the seven evaluation criteria, displayed in Table 5.3, emerged. The criteria can be classified as those for the assessment of the quantity and quality of the public benefit achieved with a specific project, the risk associated with realising the benefits and the associated costs. The quantity and quality of the benefits relate to the size and scope of the project, the fit of the project to the existing infrastructure, as well as its strategic contribution to Berlin's 'Network of Innovation'. The reputation of the bidder and the public conflict potential reflect the risk-related side. Administrative costs as a negative benefit and the funding costs served as measurement criteria on the cost side. We included administrative costs due to the client's concern about the time spent deciding on projects.

	Criterion	Indicator	Explanation	Scale types
Amount of benefit	Size of effect	Scope of the project	Area-specific performance indicators served for the assessment: number of employees affected, physical size of the area, etc.	Modified scales for different areas
	Fit into existing infrastructure	Fit into existing infrastructure	Need for the project given the existing infrastructure	Modified scales for different areas
	Strategy contribution	Contribution to 'Kompetenzfeld' strategy	Extent to which the project contributes to the development of 'Networks of Innovation' in Berlin	Modified scales for different areas
Risk of realizing benefit	Reputation of bidder	Quality of the proposal	Degree of accuracy of the submitted proposal: architectural plan, construction plan and other supporting documentation	Same scale across areas
		Cost and time frame credibility	Past experience with this bidder with respect to keeping to the declared costs and project schedule	Same scale across areas
	Conflict potential	Environmental concerns	Estimated probability of the project being cancelled due to any of those concerns	Modified scales for different areas
		Social concerns		
		Administrative concerns		
		Heritage protection concerns		
Costs	Administrative cost	Processing time (as negative benefit)	Estimated number of hours spent to process paperwork for the project to decide on funding	Same scale across areas
	Financial costs	Proposed financial funding volume of project in Euros		Same scale across areas

Table 5.3 – Criteria Classification for the SenWAF Project Evaluation (adopted from Rübcke, Vernik et al., 2006)

Fixed scales served to measure the impact of funding proposals on each of the criteria mentioned above. Fixed upper and lower points on the scales with corresponding descriptions for middle values form a flexible system within which to include additional projects at a later stage without having to adapt the whole model. In addition, 'text boxes' for different criteria values lead to a more consistent evaluation of research projects across the participating evaluators. As we had to consider a lot of criteria, we developed a number of constructed scales consisting of several sub-scales, as Bana e Costa and Beinat (2005) have outlined. The 'Reputation of bidder' criterion is a possible example of a criterion with a constructed scale. As Table 5.3 shows, 'Quality of proposal' and 'Cost and timeframe credibility' served as sub-scales for this criterion. After the elimination of unfeasible combinations of scale values on these two dimensions

(such as high quality of the request and non-credible time/cost figures), the decision makers ordered the feasible combinations according to their attractiveness on a 0 to 100 scale (Rübcke, Vernik et al., 2006). For example, a high quality proposal with a non-credible cost and timeframe receives a score of '40', as shown in Figure 5.17.

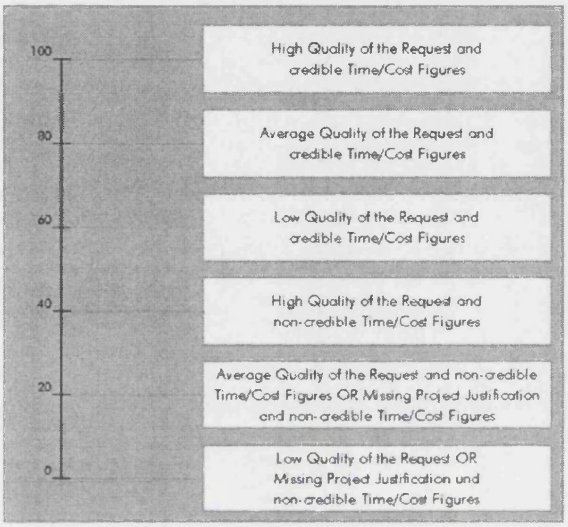

Figure 5.17 – Scale for Criterion 'Reputation of Bidder'

For three criteria, we had to modify these scales for each funding proposal area. The decision makers assessed the 'Size of Effect' criterion with, for example, hectares for the proposed development of industrial or commercial sites, the number of employee vacancies for proposals for the energy facilities and the number of tourists attracted daily for the tourist transportation proposals.

In addition to the funding areas mentioned, the model included proposals for new transport links, for vocational training facilities and for the development of industrial business sites for small and medium businesses. Using this structure, the SenWAF team assessed 39 funding proposals during the pilot study. After scoring each of the options on each of the criteria outlined in Table 5.3 and after weighting the criteria, the 'public value-for-money' of each of the proposals could be assessed. Figure 5.18 displays this process.

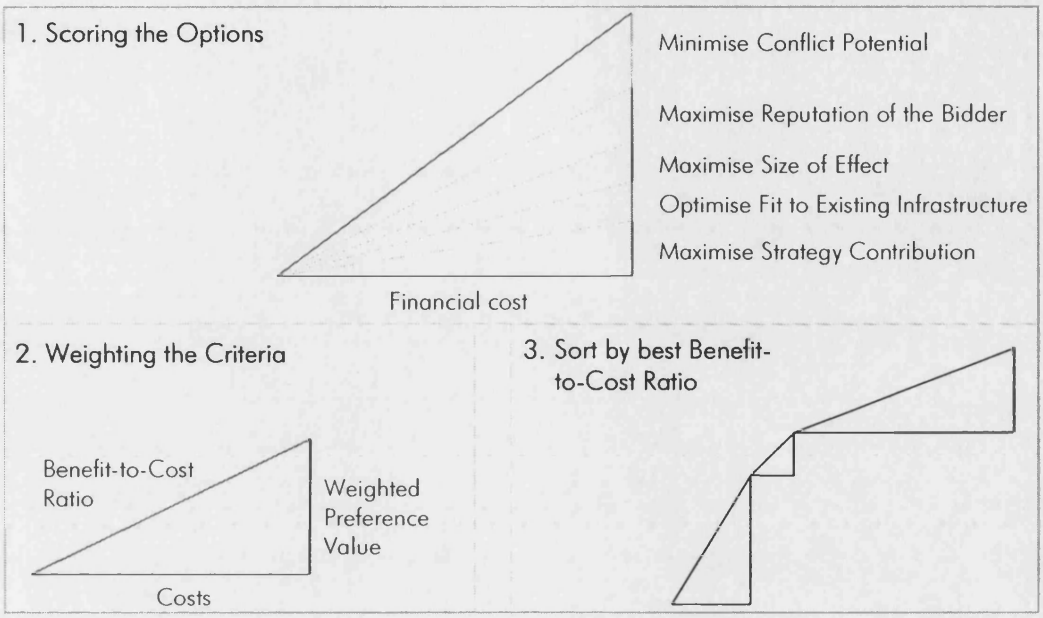

Figure 5.18 – The Process of Creating 'Public Value-for-Money' (adopted from Rübcke, Vernik et al., 2006)

The Results

Most importantly, the decision analysis for SenWAF resulted in a consistent and transparent criteria structure in the area of infrastructure funding. The documentation of the criteria continues to be used for the SenWAF's ongoing assessments of project proposals. The SenWAF is considering changing their application process, so that applicants have to provide data in line with the criteria developed. In particular, the transparent process for allocating public resources serves – according to interviews with the decision makers following completion of the project – as a basis for justifying funding decisions to the German Federal Court of Auditors. Of the 39 funding proposals analysed, twelve were accepted immediately, ten will be accepted in the year 2007, seven were withdrawn voluntarily by the applicants and 10 will be rejected. We presented the results to the state secretary of the organisation, who recommended the continued application of decision analysis for the allocation of resources in Berlin.

Together with the case on Demographic Change for Deutsche Bahn, the SenWAF project won the MARA 2006 Excellence Award. We presented the results at the Annual Meeting of INFORMS in November 2006 in Pittsburgh. One reason for the success of this project is that the analysis has fewer weak points compared to the other MARA projects. One criticism, however, could be the inclusion of the criterion 'Administrative costs' as a negative benefit. It is probably difficult to argue that, for an effective

allocation of public money, the administrative time spent in managing project proposals should play a significant role in the selection of infrastructure funding projects.

Conclusion

The four MARA partner organisations had not applied decision analysis before MARA 2006. The cases therefore provided an opportunity to diffuse knowledge on socio-technical decision analysis to a country in which decision analysis is not yet extensively applied. Besides the 'political' impact on the position of decision analysis in Germany, this chapter has served to outline the specific results of the six MARA 2006 case studies. The cases constitute a consistent research framework which served to carry out the process effectiveness and the alignment study presented in the next chapter. In addition, the case results aim to show – with a link to one of the research objectives of this thesis – that STDA can be applied successfully by a group of relatively inexperienced decision analysts.

The cases revealed several findings. We observed vaguely defined or even chaotic decision processes and, to a certain extent, excessive top-down decision making. In all cases, STDA seemed to provide a methodology which enabled decision makers to enhance information exchange in the decision process ('socio' side) and a more transparent and rational methodology in order to improve information processing (technical side). The specific effects of STDA on the perceived process effectiveness and the group alignment effects, are the core topics of the following chapter.

Chapter 6 – Effectiveness Study Results

6. MARA 2006 Empirical Results

The plural of 'anecdote' is not 'data'.

Roger Brinner

To test the effectiveness of STDA in strategy development contexts, this thesis takes a multiple angle perspective. As the limited amount of 'anecdotal' evidence, generated through the MARA cases, is insufficient to test the effectiveness of STDA in strategy development, two empirical studies provided additional data. The following chapter summarises the results of these two empirical studies. The objective of this chapter is thereby to contribute to one of the research objectives of this thesis by developing and applying measures to assess the effectiveness of STDA.

The first study focuses on decision process effectiveness of the MARA interventions compared to existing methodologies in the participating organisations. With the second study, we analysed the alignment effect of the MARA 2006 interventions by comparing preferences of the decision makers with regard to the options under consideration. The degree to which the preferences 'converged' towards the modelling results in comparison to the preferences before and after the decision conference serve as an indicator for alignment. The following sections outline the objectives, hypotheses, methods and results of both studies. More detailed data can be found in the Annexes.

6.1. MARA 2006 Decision Effectiveness Study

The objective of the first MARA 2006 study was to analyse the perceived effectiveness of the MARA 2006 cases. Following an outline of the research background and hypotheses, the following sections served to present the survey method and the results of the quantitative and qualitative analyses. The quantitative comparison between STDA, the existing processes in the organisations and a hypothetical ideal state constitute the first results. This part of the analysis includes an assessment of possible response biases of the participating decision makers. In relation to these results, each MARA case can be positioned within the socio-technical effectiveness framework, as established in Chapter 2. The presentation of the qualitative survey results and a discussion of the findings concludes the section.

Research Background and Hypotheses

The core idea for this part of the research was to measure the perceived effectiveness of socio-technical decision analysis. The Competing Values Framework for evaluating the effectiveness of group decisions (Quinn and Rohrbaugh, 1981; Quinn and Rohrbaugh, 1983; McCartt and Rohrbaugh, 1989; Reagan and Rohrbaugh, 1990) served as a starting point to develop suitable decision effectiveness dimensions. As outlined in Chapter 4, however, several shortcomings made the framework inapplicable to the evaluation of the MARA 2006 cases. The expert interviews described in Chapter 4 served to develop a more suitable framework to measure the perceived effectiveness of the MARA interventions. The following three technical, three 'socio' and two result-oriented dimensions emerged:

Technical dimensions:

- **Transparency and comprehensibility**
  The extent of transparency and comprehensibility in the process
- **Rational-based vs. intuitive-based**
  The contribution of rational analysis and intuitive judgment to the processes
- **Quality of information exchange**
  The extent of interactivity and dialogue-orientation in the processes

'Socio' dimensions:

- **General participation**
  The extent of participation by people within the organisation in the problem solving process
- **Top-down vs. bottom-up**
  The extent of top-down vs. bottom-up influence in the organisation during problem-solving processes
- **Quantity of information exchange**
  The extent of information exchange between different stakeholders

Result-oriented dimensions:

- **Creativity**
  The extent to which creativity or more traditional ideas are stimulated by the process
- **Strategic insights**
  The extent to which strategic insights are created through the process

According to the hypotheses of this research, socio-technical decision analyses, as carried out in MARA 2006 should be more effective than existing methodologies/processes on these eight dimensions in comparison to an ideal state. The *MARA score* (v_M) should therefore be closer to the *ideal score* (v_I) than the *status quo* (v_{SQ}) score. Expressed mathematically, the differences on each dimension D between the *ideal score* (v_I) and the *MARA score* (v_M)

$$D_{IM} = v_I - v_M$$

should be smaller than the differences between the *ideal score* (v_I) and the *status quo* (v_{SQ}) score:

$$D_{ISQ} = v_I - v_{SQ}$$

The hypotheses for each of the eight dimensions d can then be expressed with:

H1-H8: $D^d_{IM} < D^d_{ISQ}$

According to H1, the decision makers perceived the MARA intervention to be closer to the ideal state than the status quo with respect to transparency and comprehensibility (d=1): $D^1_{IM} < D^1_{ISQ}$

Similarly, one can denote H2 to H8 as H_d with d=2,..., 8.

$H_i = D^i_{IM} < D^i_{ISQ}$

In addition to this comparison, the effectiveness survey aims to test – on an aggregated level – whether socio-technical decision analysis improves technical information processing and involvement in strategic decision making. One possible way to aggregate the scores is to use the averages of the technical and socio dimensions, as displayed in Figure 6.2.

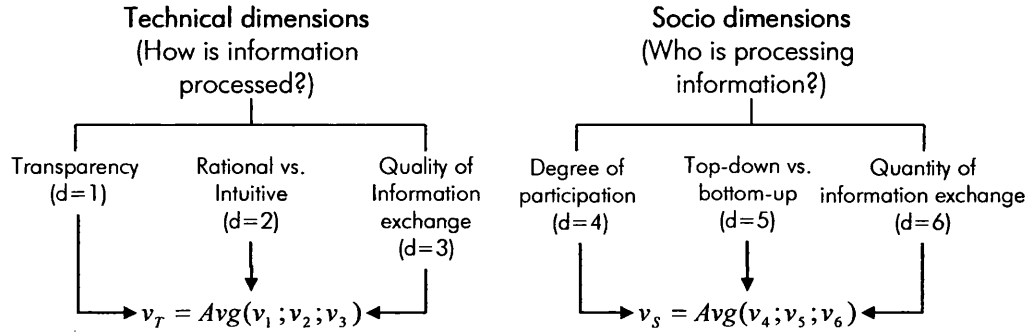

Figure 6.1 – Aggregated 'Socio' and Technical Dimensions

Transferring the hypotheses H1-H8 on an aggregated level, a constellation should emerge where, for each organisation, the *MARA* score on the 'socio' dimension v_S^M and the *MARA* score on the technical dimension v_T^M is perceived to be closer to the ideal than the aggregated *status quo scores* for both dimensions. H9 and H10 can therefore be denoted with:

- **H9 – Aggregated 'socio' dimensions**
  $v_S^{SQ} < v_S^M \leq v_S^I$ (for all six cases)
- **H10 – Aggregated technical dimensions**
  $v_T^{SQ} < v_T^M \leq v_T^I$ (for all six cases)

Survey Method

In order to be able to test these hypotheses, we asked the participating decision makers to fill out a seven-point questionnaire, similar to a likert scale. The decision makers created three data points on each of these dimensions:

- How they **rate** the **decision analysis** carried out by the MARA team ('MARA')
- How **problems similar to the one** approached by the MARA team **should ideally be solved** in the organisation ('Ideal')
- How the organisation **would ordinarily have solved** the decision problem at hand, or **problems similar to the one** approached by the MARA team with the organisation's **existing processes/methods** ('Status quo')?

An example question from the questionnaire is shown below:

1. **Extent of participation by people in your organisation in the problem solving Process**

MARA: How participatory do you rate the MARA decision analysis? (Please indicate your answer by writing an "M" at the appropriate point on the scale below.)
Ideal: How participatory should problems similar to the one approached by the MARA team ideally be solved in your organisation? (Please mark this ideal state with an 'I' at the appropriate point on the scale below.)
Status Quo: How participatory would the decision problem at hand or similar problems have been solved with the existing processes/methods (Please mark this with an 'SQ' at the appropriate point on the scale below.)

Not very participatory, including few opinions within the organisation	1	2	3	4	5	6	7	Very participatory, including a variety of opinions within the organisation

Figure 6.2 – Sample Questions of the Decision Effectiveness Study

As the decision makers could assess an ideal point on every dimension, we assumed a single peaked preference function on each of the dimensions (Coombs, 1977). The aggregated scales used in this study, in particular in the 'organisational positioning' analyses below, have some similarities to likert-typed scales (Likert, 1932). We assumed equidistance of the different scale points. As the response levels are not anchored with verbal labels, 'discrete visual analog scales' could serve as an appropriate scale label (Uebersax, 2006). We subsequently turned the 'neutral' scales into a value scale, in order to measure the distance of the *MARA* and the *status quo* scores from the individual *ideal* values. Decision makers, for example, did not view creativity *per se* as desirable. One can view, therefore, a process as too creative – relying excessively on new ideas – as opposed to balancing new and traditional ideas.

The assessment of an ideal state is, as outlined in Chapter 3, an essential one, as the definitions of effectiveness usually rests on a value statement (Campell, 1979). Previous effectiveness studies (such as Chun, 1992) usually rely on direct comparisons of

the effectiveness of organisational interventions and existing processes. If we had applied this more simple framework, asking for the degree to which decision makers perceive STDA as differently effective than existing processes, we could not have analysed deficits in current decision processes and STDA in comparison to an ideal state.

Beside these quantitative effectiveness assessments, the questionnaire also included qualitative questions on the strengths, weaknesses and improvement possibilities of STDA.

Results 1: Quantitative Analyses of Perceived Decision Effectiveness

We sent out sixty-two questionnaires to the participating decision makers of MARA 2006, of which forty-four (71%) were returned. The data of each of the decision makers on each dimension about *MARA*, the *status quo* and the *ideal state*, served to generate the two difference scores D_{IM} and D_{ISQ}. For each decision maker, we calculated the difference between the *ideal* and the *status quo* and the *ideal* and *MARA*. These differences then served to create averages across the decision makers and the six MARA cases. Figure 6.3 displays the overall averages of the scores. Figure 6.4 shows the deviation of *MARA* from the *ideal* state and the deviation of the *status quo* from the *ideal* state across all cases.

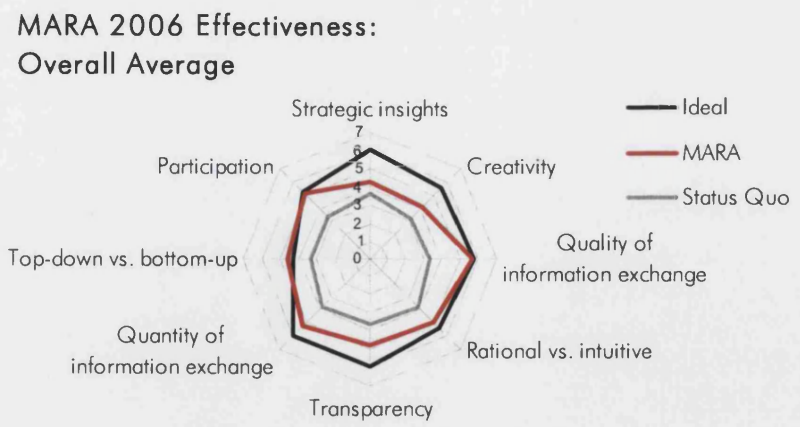

Figure 6.3 – Overall Averages of the Scores Across All Cases

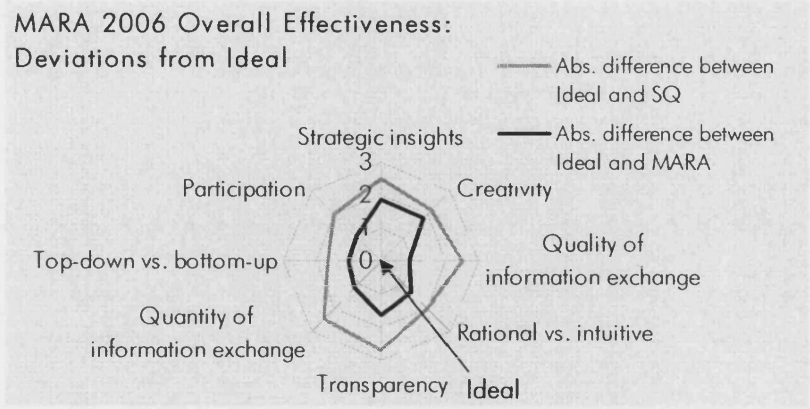

Figure 6.4 – Deviation from Ideal State – Average Across All Cases (Average Scores of MARA and Status Quo)

Dimension d	Paired Differences: Deviation Ideal and Mara with Ideal and Status Quo	Mean difference	Std. Error	T	p
1	Transparency and comprehensibility (T)	1.09	0.26	4.20	p<.001
2	Rational-based vs. intuitive-based (T)	0.64	0.20	3.17	p=0.002
3	Quality of information exchange (T)	1.66	0.20	8.18	p<.001
4	General participation (S)	0.84	0.22	3.82	p<.001
5	Top-down vs. bottom-up (S)	0.57	0.16	3.61	p=0.001
6	Quantity of information exchange (S)	1.25	0.26	4.76	p<.001
7	Creativity (R)	0.41	0.25	1.63	p=0.055
8	Strategic insights (R)	0.66	0.25	2.62	p=0.006

Table 6.1 – t-test for Paired Samples of Decision Effectiveness Values (N=44)

The results show that decision makers consistently ranked the MARA interventions closer to the *ideal* state than the *status quo*. Most decision makers perceived socio-technical decision analysis as superior on most of the eight dimensions. It is only the difference in creativity (p=.055) that is less visible in comparison with the other dimensions. One might attribute this result to the fact that most of the cases – besides DB Demographic Change and DB Investment Prioritisation – focused on the analysis of existing decision options, rather than developing exploratory new options.

The perceived difference between MARA and the status quo is in particular evident on the dimensions 'Quality of information exchange' (d=3) as well as 'Quantity of information exchange' (d=6) with respective T values of T_3= 8.18 and T_6=4.76. Both dimensions can be interpreted as 'communication' dimensions. The analysis therefore clearly confirms the communication enhancing aspect of STDA.

An analysis of the perceived ideal states on the dimensions also revealed several interesting insights. Whilst decision makers perceived the ideal states of the dimensions 'Strategic insights', 'Transparency' and 'Quantity of information exchange' across all cases as comparatively high (averages>5.9), they gave the dimensions 'Top-down vs. bottom-up' and 'Participation' comparatively low scores (averages of 4.2 and 5.1, respectively). A low aspiration on 'Top-down vs. bottom-up' and 'Participation', however, somewhat contradicts a high aspiration on 'Quantity of information exchange', as all three dimensions aim at higher involvement in decision making processes. One might explain this inconsistency by the acknowledgement on the part of the decision makers that diverse information input is beneficial, but only when done in a time efficient way (limited quantity of information exchange). The qualitative results, outlined in section 6.1.5, confirm the interpretation of these results.

Figure 6.5 below displays a more detailed analysis of the decision effectiveness evaluation of the individual MARA cases. Besides the FBH Appraisal case, the decision makers perceived the MARA interventions on all dimensions to be more effective than the status quo. Due to the relative small sample size (N=6 to N=11), further statistical testing of the individual cases would not lead to meaningful results.

Across The MARA Cases STDA Was Perceived Consistently As More Effective Than Existing Decision Processes

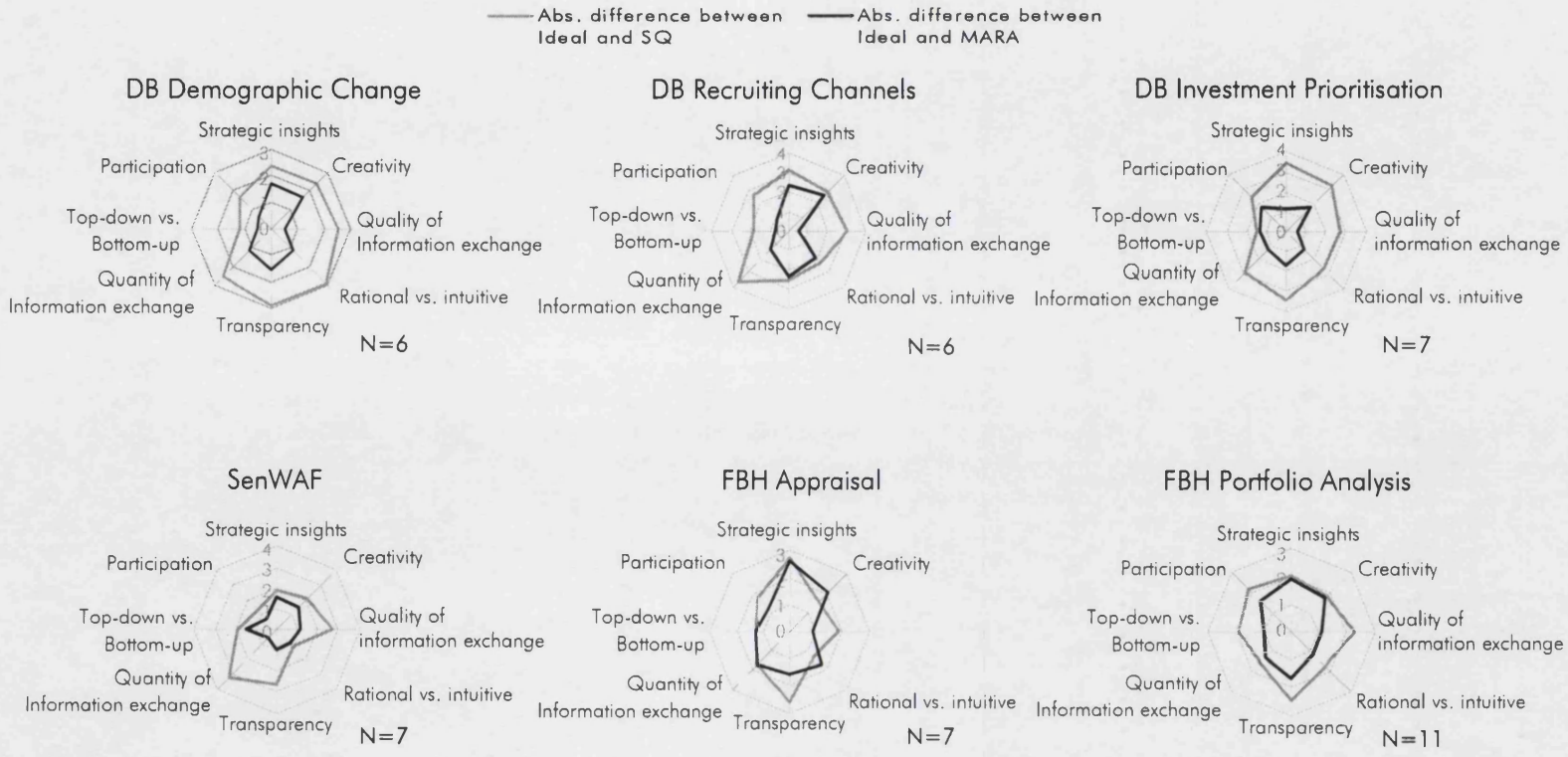

Figure 6.5 – Deviation from Ideal for all MARA 2006 Cases (Average Scores of MARA and Status Quo)

As the MARA environment – a special research setting – could have caused biases on the part of the participating decision makers in favour of STDA, we tested the relationship between the degree of commitment to the project C_{DM} and the overall effectiveness score E_{DM} for each decision maker *DM*.

To calculate the commitment score C_{DM} each member *m* of the different MARA project teams rated the degree of commitment of each decision maker C_{DM}^{m} on a seven point Likert scale. The scale ranged from very low support, very low engagement and very low motivation ($C_{DM}^{m}=1$) to very high support, very high engagement and very high motivation ($C_{DM}^{m}=7$). We calculated the overall commitment score for each decision maker C_{DM} as the average commitment assessment of the MARA team members m=1...n:

$$C_{DM} = \frac{\sum_{m} C_{DM}^{m}}{n}$$

To derive the overall effectiveness score E_{DM}, we calculated for each decision maker the average increase of the perceived effectiveness between the MARA application and the status quo. The effectiveness score for each decision maker *DM* on the decision process dimensions *d* can therefore be denoted with:

$$E_{DM}^{d} = \left| v_{I}^{d} - v_{SQ}^{d} \right| - \left| v_{I}^{d} - v_{M}^{d} \right|$$

If a decision maker, for example, assessed the ideal on the dimension d=8 ('Strategic insights') with $v_{I}^{8}=5$ the MARA score with $v_{M}^{8}=4$ and the status quo score with $v_{SQ}^{8}=3$, his/her effectiveness score would be 1. MARA would, in this case, be perceived as one unit better than the status quo in comparison to the ideal. We can therefore calculate the overall effectiveness score for each decision maker E_{DM} as his/her average effectiveness score across the eight dimensions d:

$$E_{DM} = \frac{\sum_{d=1}^{8} E_{DM}^{d}}{8}$$

We then analysed the correlation between the degree of commitment of each decision maker C_{DM} with his/her overall effectiveness score E_{DM}. For an unbiased assessment of the effectiveness of the MARA interventions, we would ideally expect the commitment to the project to be independent of the perceived effectiveness. Assuming some variance in the effectiveness perceptions, some of the highly committed decision makers should therefore assess the MARA interventions as ineffective, and some of the less committed decision makers should perceive MARA as highly effective. The results displayed in Figure 6.6 confirm this relationship.

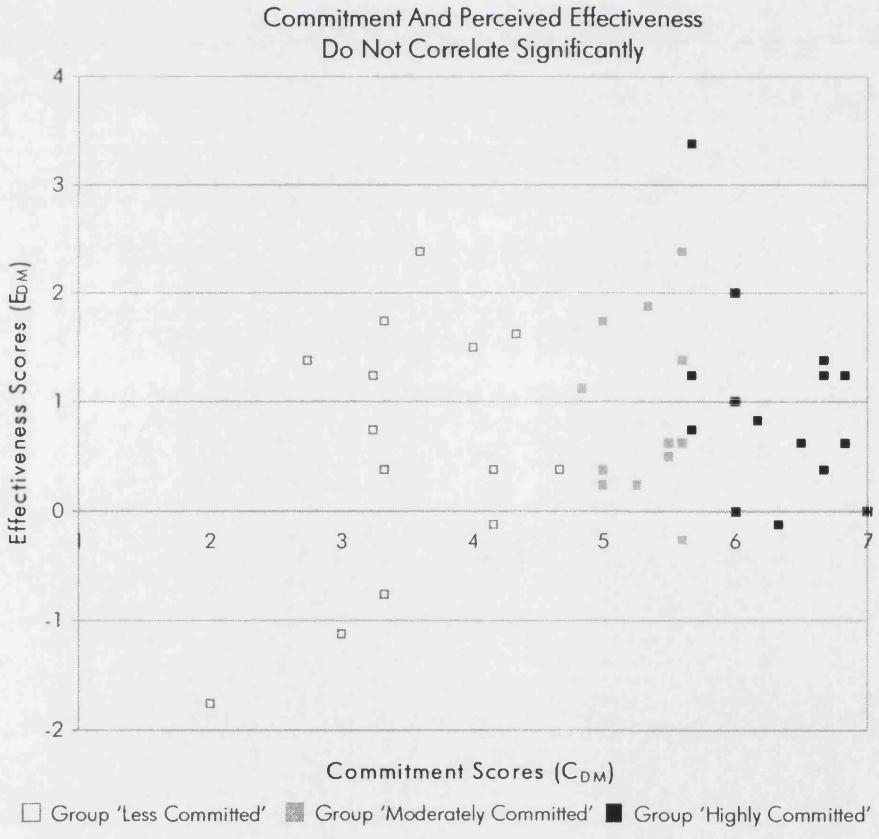

Figure 6.6 – Correlation Between Commitment Scores C_{DM} and Effectiveness Scores E_{DM}

The correlation between C_{DM} and E_{DM} is r=.219. The perceived effectiveness can therefore be regarded as not significantly correlated with the commitment scores

(p=.153). For a more detailed analysis, we divided the decision makers into three similar sized groups according to their degree of commitment, as described in Table 6.2.

Group	N	Interval	Mean E_{DM}	Variance E_{DM}
Less committed	14	2 ≤ CDM ≥ 4.7	0.57	1.41
Moderately committed	14	4.7 < CDM ≥ 5.6	0.96	0.60
Highly committed	16	5.6 < CDM ≥ 7	1.00	0.74
Overall	44	1 ≤ CDM ≥ 7	0.85	0.86

Table 6.2 – Analysis of the Effectiveness Scores of Three Differently Committed Groups

In particular in the less committed group, the variance of E_{DM} increased substantially in comparison to the other two groups. This is, however, mainly due to the three outliers, as displayed in Figure 6.6. As indicated by the positive mean of E_{DM} even the less committed group perceived STDA as on average better than the status quo. Figure 6.7 confirms these results on the level of the individual dimensions.

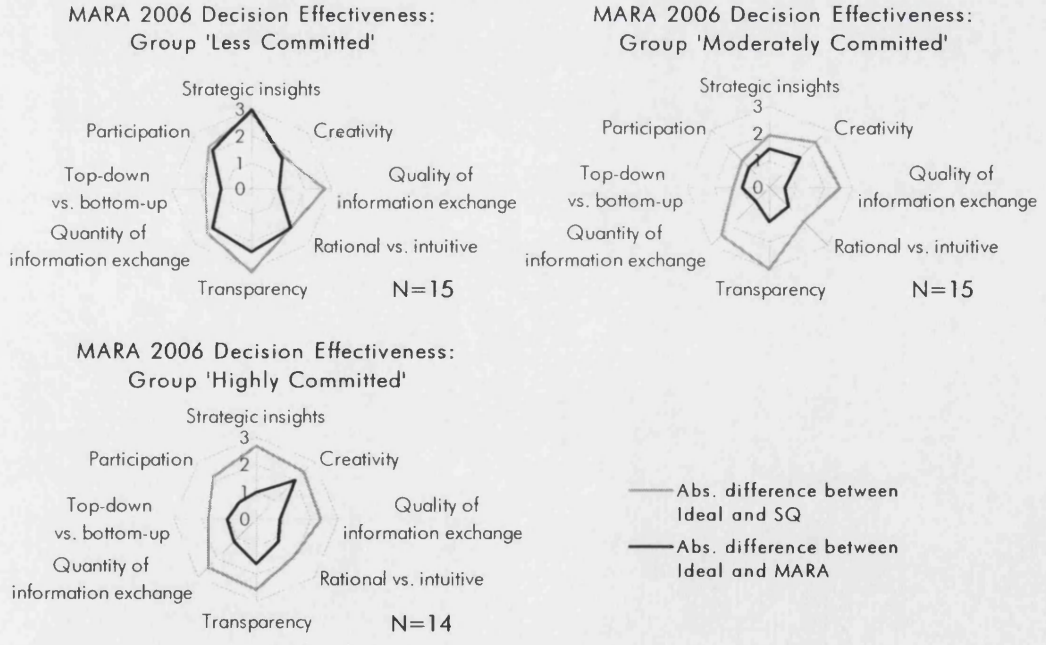

Figure 6.7 – Effectiveness Scores for Three Differently Committed Groups of Decision Makers

A lower commitment leads to somewhat smaller differences in the assessment of the status quo scores and the MARA scores, as depicted in Figure 6.7. The main reason for the observed differences are the three outliers in the less committed group, mentioned above. Disregarding these outliers, the mean for the less committed group is

slightly above the highly committed group (E_{DM} (less committed without outliers) = 1.06). Hence, the commitment in general does not seem to make a significant difference to the effectiveness assessment. As shown in Figure 6.7, the decision makers perceived STDA, independently of their degree of commitment, as more effective than existing processes.

Results 2: 'Organisational Positioning' of the MARA Partners using the Socio-Technical Effectiveness Framework

In addition to considering the individual dimensions, as outlined above, the results of the MARA 2006 decision process study can be analysed on an aggregated level. As depicted in Figure 6.2, we can plot the study results based on the technical scores v_T and the 'socio' scores v_S. Figure 6.8 shows the results for the aggregated values for all MARA 2006 cases. According to these results, the participating decision makers in MARA 2006 rated socio-technical decision analysis as both more effective on information processing (technical dimension) and on involvement ('socio' dimension) in comparison with the status quo.

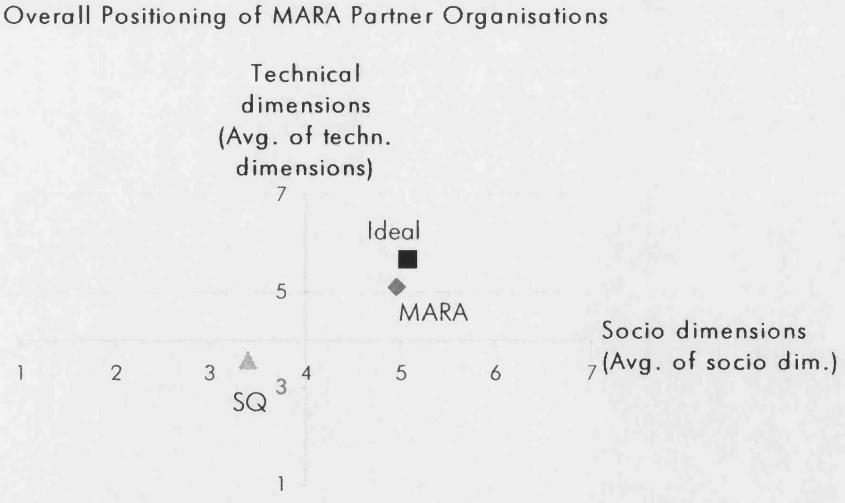

Figure 6.8 – Plot of the Average Scores of all MARA 2006 Cases on the Aggregated Socio and Technical Dimensions (N=44)

Analysing these results on a case-by-case basis, several new insights emerge. As shown in Figure 6.9, decision makers perceived socio-technical decision analysis as a significant improvement on the status quo. However, in three cases, DB Station &

Service, SenWAF and FBH Appraisal, the decision makers perceived the improvement on the socio side as somewhat excessive – the aggregated values on the socio dimension of MARA (v_S^M) is higher than the ideal point (v_S^I). There seems to be a tendency for the perceived effectiveness of involvement to peak at a certain level, especially when the time involved is too high. According to these results, STDA seems to have more effects on the socio than on the technical side. The qualitative survey results, analysed below, confirm both the strength of the approach on the 'socio' side and its weakness as a high time consuming process. In the SenWAF case, in addition, decision makers appear to have perceived STDA as fostering both excessive involvement ($v_S^M > v_S^I$) and technical information processing ($v_T^M > v_T^I$). The reason for this might be that we applied STDA in the SenWAF case to a relatively simple problem with a limited number of options.

From An Aggregated Perspective STDA Applications Were Perceived As More Effective On the Socio And On The Technical Side Than The Status Quo

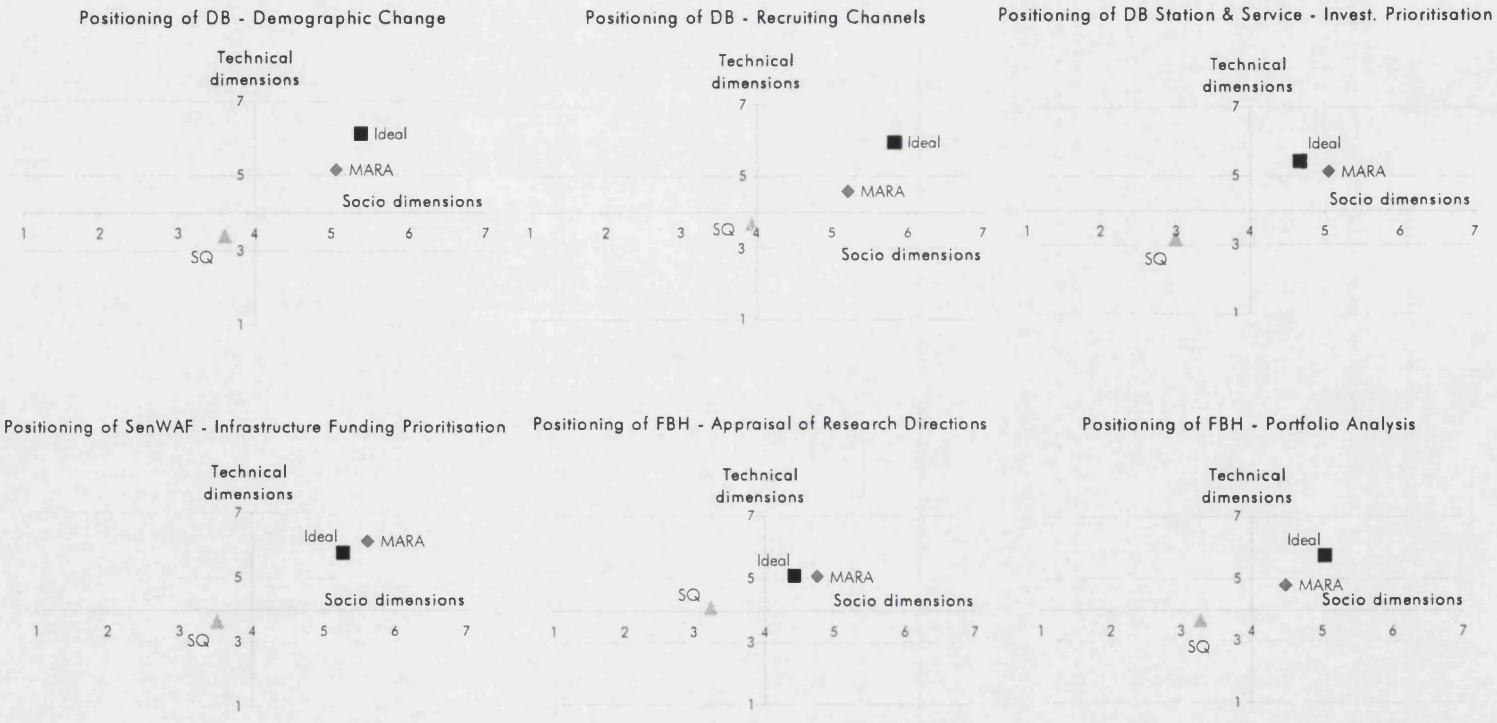

Figure 6.9 – Plot of the Average Scores of each MARA 2006 Case on the Aggregated Socio and Technical Dimensions

Results 3: Qualitative survey results

In addition to the quantitative assessments, outlined above, the decision makers who participated in the survey evaluated the strengths and weaknesses of socio-technical decision analysis, as well as the ways in which the method could be improved. I outline below the data analysis methodology and the results of this part of the study.

Data Analysis

The survey participants assessed STDA with N=139 qualitative statements. Based on this data, we developed classification categories (see Bortz and Döring, 1995). The results graphs below display these different categories. We defined the categories as clearly as possible in order to ensure sufficient inter-rater reliability. Sentences or fragments of sentences of the decision makers' responses served as coding units. Cohen's Kappa (Cohen, 1960) served to assess the inter-rater reliability values of the two researchers who coded the statements independently:

$$\kappa = \frac{p_0 - p_C}{1 - p_C}$$

p_0 is thereby the number of coding units on which the researchers agree, whilst p_C relates to the number of agreements which can be expected by chance. The weighted averages of Cohen's Kappa across the three categories, strengths and weaknesses, as well as suggestions for improvement, was $\kappa_{Total} = 0.80$. The individual Cohen's Kappa as measurement for the inter-rater reliability were $\kappa_{Strengths} = 0.79$, $\kappa_{Weaknesses} = 0.79$, $\kappa_{Improvement} = 0.89$. We can therefore assume a high degree of reliability of the coding scheme.

Strengths of STDA

As Figure 6.10 displays, the decision makers rated the effective information transfer (socio dimensions) as the greatest strength of the approach. In this context, 23 out of 63 statements related to 'interactive and dialogue-oriented information exchanges' and 'high participation in general'. On the technical side, 20 of the statements related to systematic, structured and more 'rational' discussions, as well as an effective 'transfer of data and opinions' – within and between different departments. In addition, 12 of the statements indicated that STDA would provide a more transparent, comprehensible and comparable decision process.

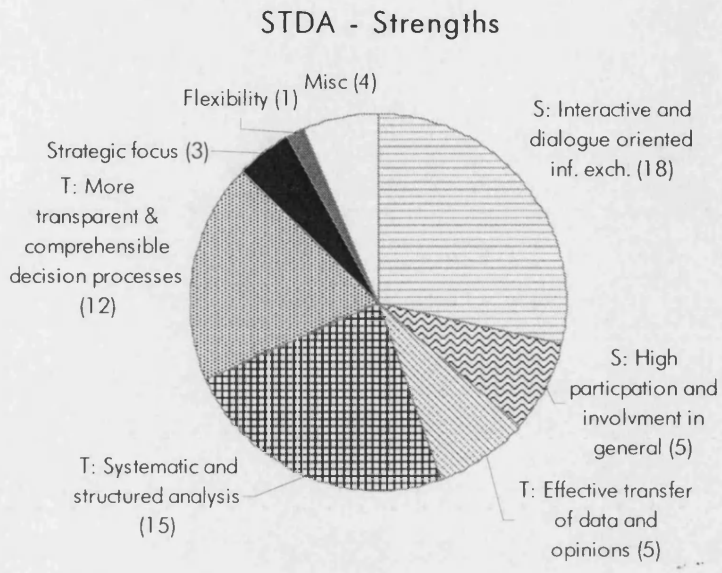

Figure 6.10 – Qualitative Evaluation of the Strengths of STDA (N = 63 statements)

Weaknesses of STDA

Figure 6.11 displays the core weakness of STDA, as indicated by the participating decision makers. Of the responses, 10 out of 48 statements indicate that some of the decision makers perceived the processes as 'too subjective', 'pseudo-precise' or 'pseudo-scientific'. One reason for this result might be the lack of sensitivity analyses performed by the facilitators. When the facilitator, as in the context of MARA 2006, is inexperienced, lack of time to carry out these analyses at the end of the decision conference can account for this phenomenon. Another important weakness was that eight of the statements referred to the large amount of time involved in carrying out a STDA. Specifically, the decision makers mentioned lengthy and unnecessary discussions. Of the 48 statements, nine referred to difficulties when assessing the data and in particular the need to carry out further studies. In addition, three of the statements focused on an insufficient content contribution from the MARA teams. This criticism of the process consultancy mode, common across MARA 2005 and MARA 2006, will form the basis for further developing STDA, as outlined in Chapter 7. Finally, three of the statements mentioned the high process complexity and the need to make further tests to judge the weaknesses of the approach.

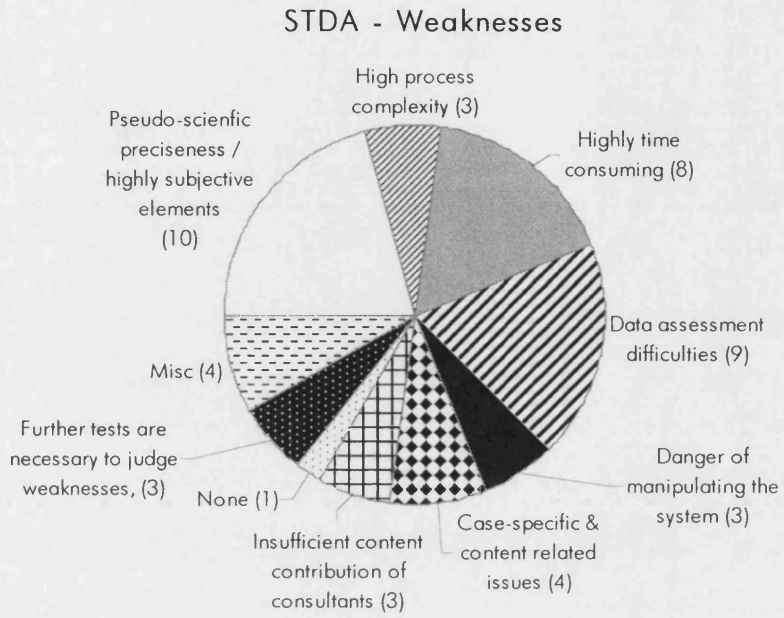

Figure 6.11 – Qualitative Evaluation of the Weaknesses of STDA (N = 48)

Improvement Possibilities of STDA

With regard to the most important possibilities for improving STDA, the decision makers suggested changes in the process quality (16 out of 48) and process transparency (6 out of 48). The suggestions for improvement in process quality referred to:

- a more careful definition of criteria to enhance the consistency of the results,
- improved weighting procedures,
- the use of comparable options,
- the use of more time for the analysis and
- the design of a shorter and more precise process.

The process transparency suggestions referred to a better introduction to the whole process beforehand. As Figure 6.12 shows, decision makers also suggested an increase in the degree of involvement and mentioned the fact that further applications should reveal further improvement opportunities.

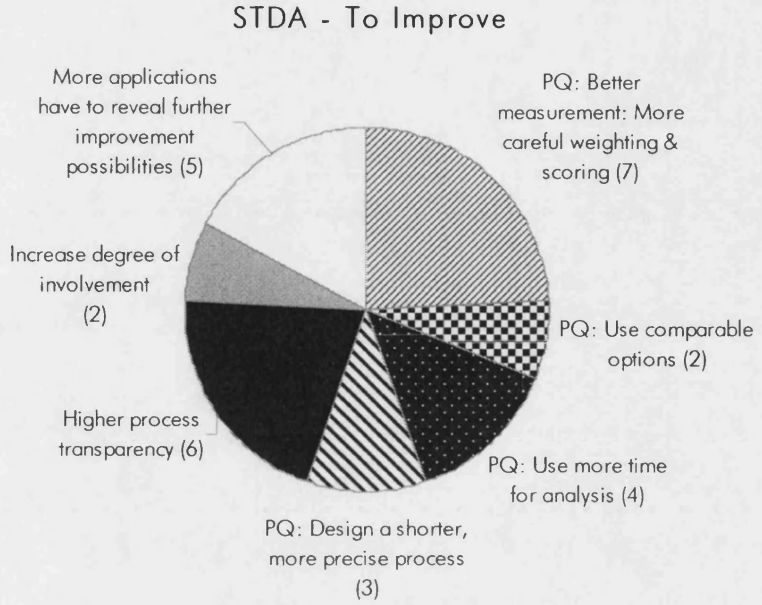

Figure 6.12 – Qualitative Evaluation of Possibilities for Improving STDA (N = 29)

Discussion

The qualitative analysis and the quantitative results, displayed above, point in the same direction. The participating decision makers perceived STDA as effective both on the 'socio' side (interactive dialogue orientation, effective involvement, effective transfer of data and opinions) and on the technical side (systematic, transparent, structured and more 'rational' information processing). However, they recognised certain weaknesses, in particular the time consuming and the 'pseudo-precise' or 'pseudo-scientific' approach. Combining the quantitative and the qualitative survey results, decision makers seem to have perceived the approach as clearly more effective than existing processes/methods for strategic decision making – if performed time-efficiently, with more carefully defined options, criteria and improved weighting procedures. As an indication of this, several survey participants expressed the need for further applications.

However, several shortcomings of the survey-based analysis described above have to be recognised. First, MARA 2006 may have created a research setting that generated a bias towards STDA. To test one possible bias, we analysed the dependence of the effectiveness assessments on the degree of commitment to the MARA project. The judgment on the effectiveness of the approach of a biased decision maker would probably depend on his degree of commitment. However, despite some higher variance in the effectiveness scores in the less committed group, the correlation between

effectiveness and commitment is insignificant. In addition to such bias, the five senior decision makers who 'bought' the MARA projects could, in particular, have had an incentive for rating STDA as particularly favourable. To test this possibility, we excluded the rating of these five senior decision makers from the analysis. The new p values still resulted in highly significant results in all dimensions, except the creativity dimension. In this dimension, the difference of the MARA score from the ideal point, and the difference of the status quo score and the ideal state was even smaller (p_{old}=.06; p_{new}=.13). Due to the exclusion of the senior decision makers, this difference on the dimension 'Strategic insights' (p_{old}=.006; p_{new}=.03) also decreased. Despite these small variations, we can rate the results as highly robust to potential biases on the part of the senior decision makers.

To exclude another possibility of bias, the demand bias, we did not reveal the hypothesis that STDA might be rated as better on the effectiveness dimensions than existing processes. Otherwise, survey participants might have had an inclination to respond in a favourable way regarding the objectives of the study. The frame of the survey was a 'neutral' evaluation study on the effectiveness of STDA compared to existing processes. To emphasise this point, we sent the survey with a neutrally formulated email.

In addition to the possibility of biased answers, second, the position of the decision makers in the organisation might have influenced their answers. To test this, we compared the ratings of three clearly identifiable project leaders on the side of the decision makers to the answers of the rest of the sample (Head of HR strategy at Deutsche Bahn, Director of FBH, Head of the Department of Funding Policy at SenWAF). For Deutsche Bahn Station & Service, no clear leader was evident as two middle managers sponsored the project and the CEO did not participate in the survey. These leaders rated the differences between the ideal state and the status quo on all dimensions as higher than the rest of the sample, with the exception of the transparency dimension. Obviously, the leaders were less satisfied with the current processes in their organisations and saw a greater urgency for change. With regard to the comparison of MARA to the ideal state, they rated STDA on the three 'socio' dimensions as slightly worse than the rest of the sample. This might be due to the fact that lower levels in an organisation profit from an increase in diversity of views over-proportionally in comparison to the leaders. On the other hand, the leaders assessed STDA as even closer to the ideal than the 'followers' on the dimensions, quality of information exchange and

rationality of the processes. As one interpretation, leaders seem to value the improved information processing due to STDA higher than the rest of the sample, as a high degree of complexity usually becomes more salient at the top of organisations.

Third, the analysis focused on *perceived* effectiveness. Perceived effectiveness can deviate from more objective measures of effectiveness. On the other hand, effectiveness is a construct with underlying value statements (Campell, 1979). As we designed the questionnaire in such a way that the decision makers could indicate their values on the evaluation dimensions, the results reflect the effectiveness in relation to their own value statements.

Fourth, questionnaires are usually completed by decision makers who are either very satisfied or very unsatisfied with the decision process. We can, therefore, only view them as partly representative of all the participants in MARA 2006. A response rate of 71%, however, indicates a sufficiently large sample size to make a generalisation over all participating decision makers in the context of MARA 2006.

Finally, whilst we can possibly generalise the results over all participating decision makers in MARA 2006, we should use them with caution as far as statements about STDA in general are concerned. As described in Chapter 4, relatively inexperienced decision analysts performed the analyses in a special setting, so we have to attribute certain results to the MARA environment. However, the clear indication that the survey participants ranked STDA as consistently better than traditional processes – despite the involvement of junior analysts – seems to count in favour of a somewhat broader generalisation of the results.

6.2. MARA 2006 Alignment Study

The objective of the second effectiveness study relates to the potential alignment effect of socio-technical decision analyses. The decision makers should not only perceive the MARA interventions as more effective, but the processes should also lead to a higher degree of shared understanding and agreement on the way forward (Phillips and Bana e Costa, 2007). The MARA 2006 case studies served to measure this alignment effect. I discuss the method, hypotheses and results of the second MARA 2006 effectiveness study in the next section.

Research Method

Within the framework of MARA 2006, we elicited the preferences of each decision maker with respect to each option under consideration. We measured these preferences both before and after the decision conferences. The decision makers thereby 'holistically' ranked their preferences in relation to the respective options. Before the decision conference, we evaluated the preferences at the beginning of the individual scoring meetings. We assessed the values after the decision conference as soon as we analysed and presented the case results to the clients. Most clients stated their preferences for the options under consideration, both on an interval scale and an ordinal scale. However, as several decision makers were unable to rigorously assess intervals, we decided to use only ordinal data for our final analysis.

In addition to the data collected before and after the decision conference, we used the group scores from the decision conference model as a third data point. In the FBH appraisal case, the weighted total values of each option served to generate the ranking of the group's preferred options. In the portfolio-based cases, we used the total benefit/cost ratios (order of priority lists).

As several options were re-named during the decision conference and we could not clearly attribute some ex-ante rankings to options under consideration, we had to exclude some data points in the following analyses. This accounts especially for DB Station & Service, where the CEO identified three areas, which should be be excluded from the decision analysis.

Hypotheses

The basis of our second study is the hypothesis that decision conferences have a consistent 'alignment impact' on the decision makers' aggregated preferences. After the decision conference, we expect their aggregated preferences for the options under consideration to be closer to the decision conference value. We denote the preferences of the decision makers with v_i^t - i refers to the option and t to the measurement point in time. The average difference between the preferences before the decision conference (t=-1) and the decision conference value (t=0) can be expressed as:

$$D_{before} = \left| v_i^0 - v_i^{-1} \right|$$

If the absolute difference between the decision conference value (t=0) and the average preferences after the decision conference (t=1) is expressed as:

$$D_{after} = \left| v_i^0 - v_i^1 \right|$$

the hypotheses for all six MARA 2006 cases (H1-H6) and the across case analysis (H7) are therefore:

H1-H7: $D_{before}^h > D_{after}^h$

According to these hypotheses, several alignment/mis-alignment examples are imaginable. Figure 6.13 (left side) displays two possible alignment effects: the average difference in preference between the initial evaluation and the decision conference value (D_{before}) is in both cases greater than the difference between the decision conference value and the final preference value (D_{after}).

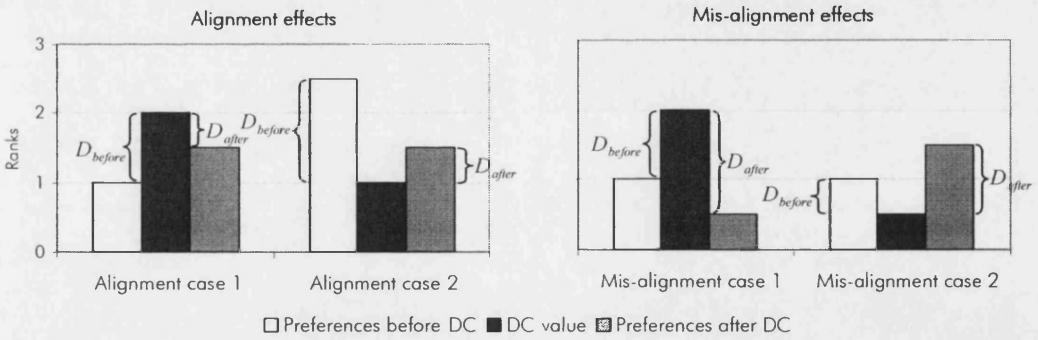

Figure 6.13 – Examples of Possible Alignments and Mis-alignments

The mis-alignment examples on the right hand side, on the other hand, depict cases where the aggregated preference difference before the decision conference (D_{before}) is smaller than the aggregated difference after the decision conference (D_{after}).

According to this approach, it is possible to calculate an alignment value AV as

$AV = D_{before} - D_{after}$

A positive AV indicates alignment, a negative value, mis-alignment.

Results

The results of the alignment study constitute the core of this section. Across the six MARA 2006 cases, we used socio-technical decision analyses to evaluate 173 options. Sixty-two decision makers participated in MARA 2006, and forty-three provided data for the alignment study. As the sample size is relatively small, I performed the subsequent analysis on a non-parametric basis (sign test). Figure 6.14 displays the across case analysis of the alignment effects.

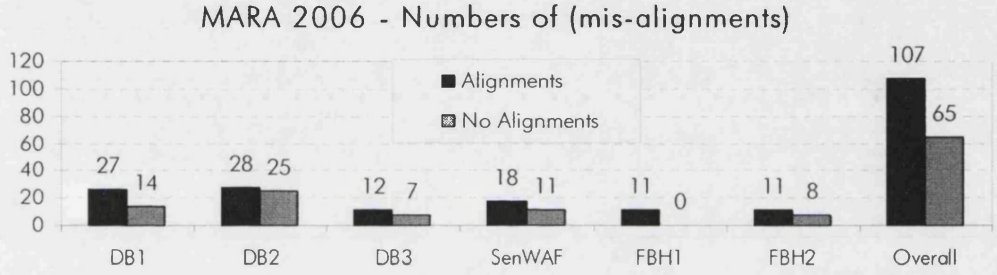

Figure 6.14 – Overall Alignment Effects Across MARA 2006

Across the MARA 2006 cases, the interventions aligned the decision makers in 107 of 172 cases (62.20%; p=.001). On an individual case basis, the difference between alignments and mis-alignments is significant for the DB Demographic Change case (p=.031) and in particular for the FBH Appraisal case (p=.002). The results from the other four cases point in the right directions but are not significant. Table 6.3 sets out details of the test results.

Sign test on alignment values	AV>0 (alignment)	AV<0 (mis-alignment)	AV=0 (no effect)	Z	p (sign test)
MARA 2006 overall	107	65	1	-3.126	p=.001
DB Demographic Change	27	14	0	-1.874	p=.031
DB Recruiting Channels	28	25	0	-0.275	p=.392
DB Investment Prioritisation	12	7	1	-0.604	p=.273
Sen WAF	18	11	0	-1.114	p=.133
FBH Appraisal	11	0	0	-2.934	p=.002
FBH Portfolio Analysis	11	8	0	-0.282	p=.342

Table 6.3 – Sign test for Ordinal Alignment Data (N=173 options)

The following section depicts the results of the FBH appraisal case in more depth. The decision makers in this case were physicists and continuously emphasised a preference for high quality judgmental data. Accordingly, we can judge the data quality of the FBH Appraisal case to be particularly high.

FBH Appraisal Case

In the FBH appraisal case, for every option, the aggregated preferences difference before the decision conference (D_{before}) was greater than the aggregated preferences difference after the decision conference (D_{after}). Figure 6.15 displays the decision conference values of this case, as well as D_{before} and D_{after}.

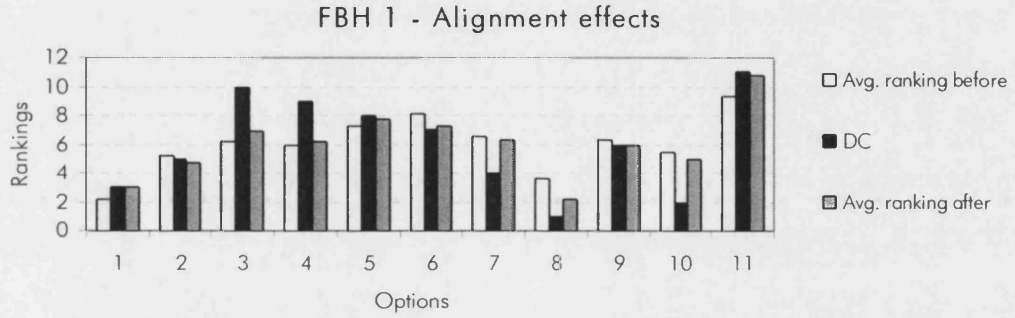

Figure 6.15 – FBH Appraisal Case: Aggregated Preference Values Before and After the Decision Conference

The clear alignment effect with the corresponding alignment values (D_{before} - D_{after}) is depicted in Figure 6.16. The FBH case resulted in a positive alignment value for every option, as indicated by the eleven bars pointing to the right. The decision conference seems to have a consistent alignment effect as the differences of the aggregated preference values for all options under consideration after the decision conference is closer to the decision conferencing value than the preference values before the intervention.

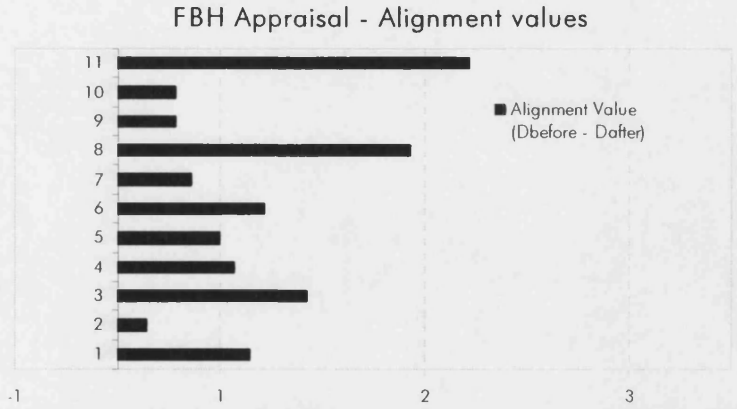

Figure 6.16 – FBH Appraisal Case: All Eleven Options Led to an Alignment Effect (Positive AV)

The other five MARA 2006 cases have been analysed correspondingly. The sum of the alignment values in each MARA case is positive, indicating that more alignment than

misalignment occurred. The results, however, vary substantially between the cases. Whilst the results for the FBH Appraisal case (p=.002) and the Demographic Change case (p=.031) indicate a clear alignment, alignment was difficult to measure especially in the Recruiting Channel project (p=.392) and the FBH portfolio analysis case (p=.342). Figure 6.18 and Figure 6.19 display the results for the individual cases. The results are discussed below.

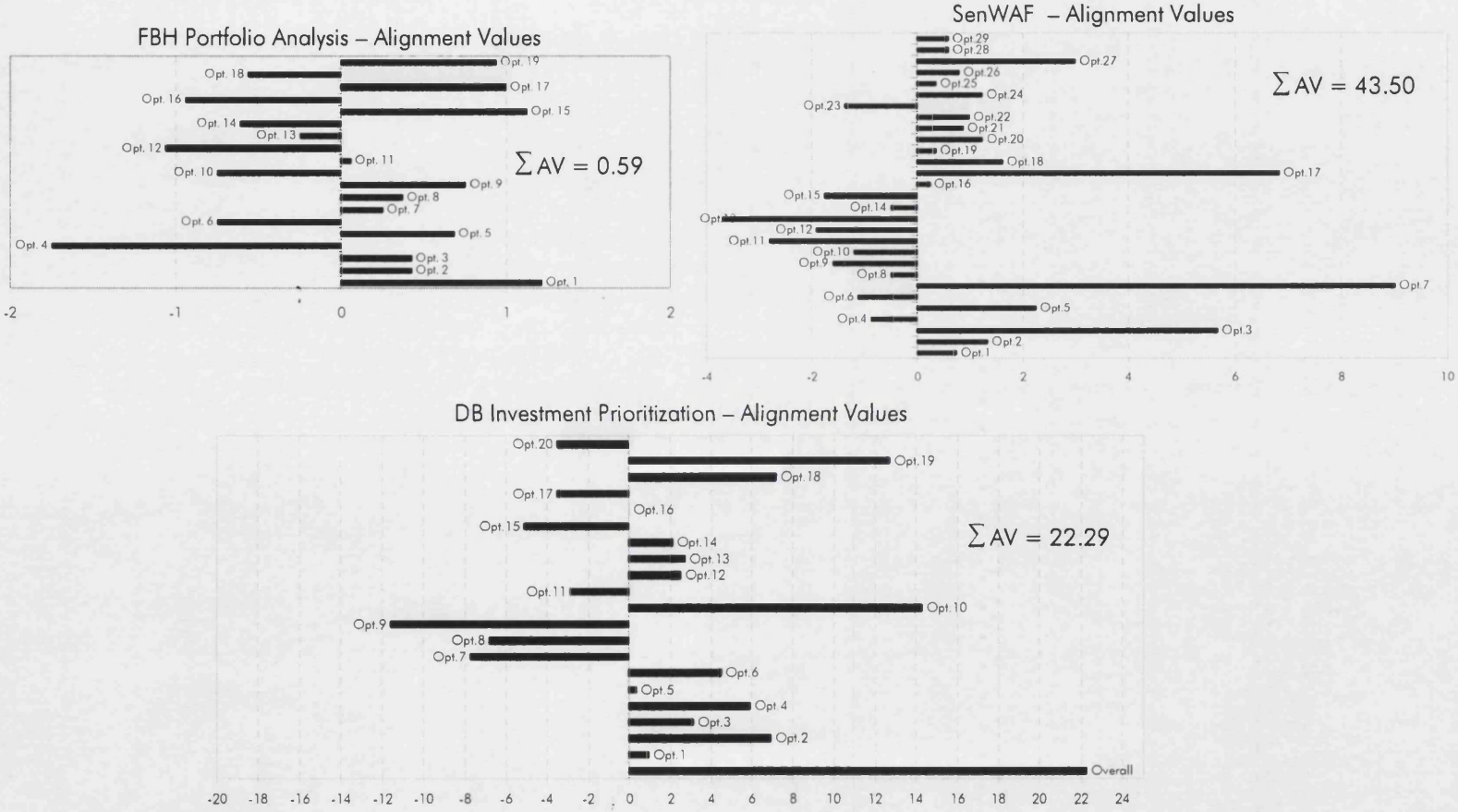

Figure 6.17 – Alignment Values for the MARA 2006 Cases: FBH Portfolio Analysis, SenWAF and DB Investment Prioritisation

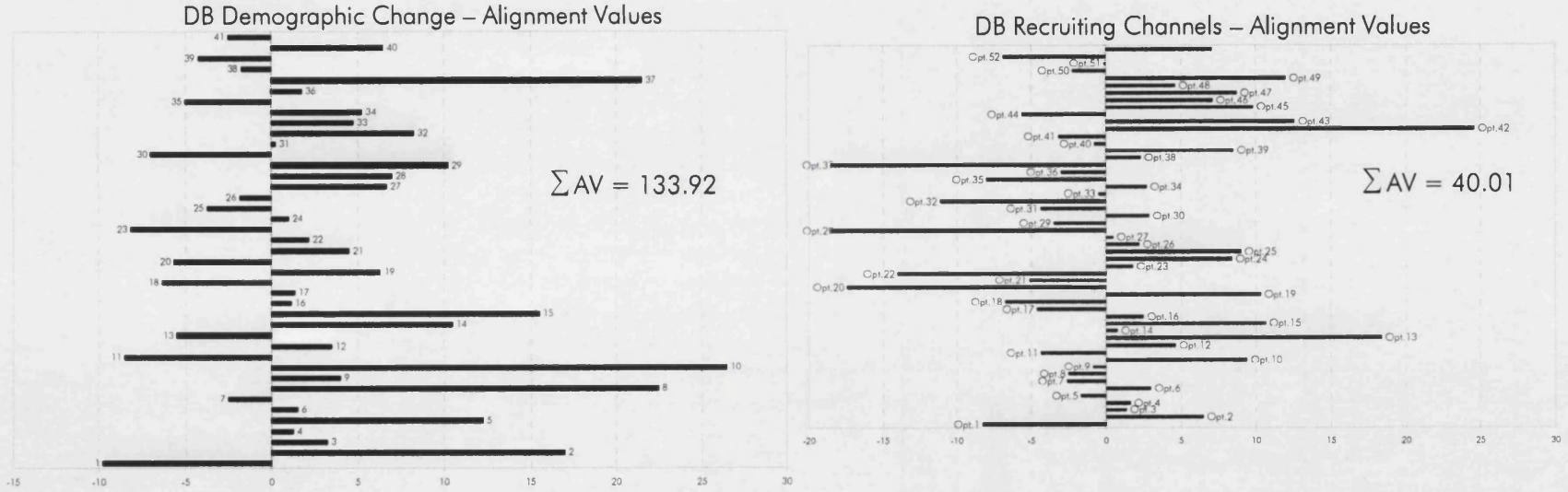

Figure 6.18 – Alignment Values for the MARA 2006 Cases: DB Demographic Change and DB Recruiting Channels

In addition to the analysis of alignment values, we can interpret the variances of the decision makers' preferences as one measurement of alignment. If socio-technical decision analysis aids decision makers to agree on a joint way forward, the variances of their preferences after the decision conference should decrease compared to their variances before the application. If we denote the standard deviation of the decision makers to their judgments for options i with σ_i^t, where t=-1 refers to the situation before the STDA application and t=1 to the standard deviation after the STDA application, the decrease in variance can be expressed with:

$$\sigma^i_{before} > \sigma^i_{after}$$

Therefore: $\sigma^i_{after} - \sigma^i_{before} < 0$

Figure 6.17 depicts the results of the analysis for the FBH appraisal case. In accordance with this hypothesis, the standard deviations of the decision makers' judgments decreased in 8 out of 11 cases.

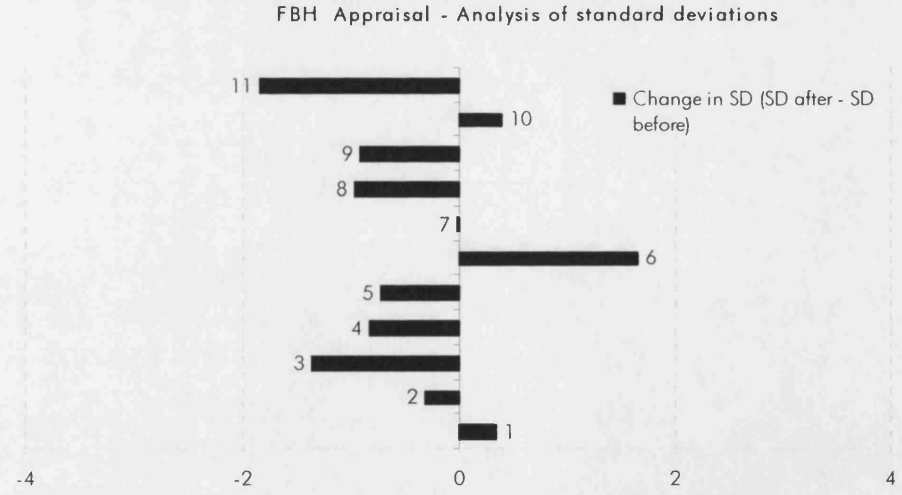

Figure 6.19 – Analysis of Standard Deviations for the FBH Appraisal Case

When analysing the other – more complex – cases, this relation, however, did not emerge. High measurement errors of the alignment study and a large amount of data to be processed by the decision makers in the portfolio cases, are potential causes of this result.

Discussion

The overall results of the alignment study indicate clear alignment effects of STDA in the context of MARA (alignment in 107 of 172 cases; p=.001). We can interpret this as an indication of the ability of STDA to create strategic alignment amongst a diverse group of stakeholders. However, several shortcomings of the analysis have to be recognised.

First, the preference assessment of the decision makers might be partially imprecise due to the field study character of MARA. We gathered the data during the process of MARA 2006, when time was scarce and the decision makers were under a high amount of pressure. Although the interviewers were thoroughly trained, as outlined in Chapter 4, some experimenter effects could also have occurred due to the fact that there was a different interviewer on each project.

Second, additional measurement errors could have occurred due to the high amount of information that had to be processed. Some results of the decision conferences were difficult for the decision makers to process, especially in the portfolio analysis cases. The number of options under consideration exceeded twenty-five in the DB Demographic Change, the DB Recruiting Channel and the SenWAF cases. Decision makers, therefore, had to process a large amount of data before, during and after the decision conference.

Finally, due to the research setting, we could establish no 'counterfactual'. STDA could ideally have been compared to a case without an STDA application in order to observe the differences in results to be observed. We can therefore only draw the conclusions for different data points in time or with a relation to existing processes, rather than between methodologies.

Due to the simple case structure of the FBH Appraisal case, some of the shortcomings in relation to the measurement errors should apply to a smaller extent. The clear results of this case might, therefore, be interpreted as an indicator for the alignment effect of STDA in the MARA context. Nevertheless, due to the shortcomings mentioned above, the alignment study needs to be viewed as somewhat less meaningful for this research than the decision effectiveness study. Both, however, point in the same direction, as hypothised in Chapter 2 and Chapter 3.

Due to the special research setting of MARA 2006, the empirical results of the two studies outlined above should be viewed with appropriate caution in relation to

statements about STDA in general. However, the decision effectiveness study, in particular, and, to a lesser extent, the alignment study, clearly indicate that STDA has been perceived as more effective than traditional methodologies. Effectiveness in this context refers, on the technical side, to more effective information processing: a more transparent process, leading to better and more 'rational' information exchange between the participating stakeholders. On the 'socio' side, the approach leads to the more effective involvement of participating decision makers. It increases the exchange of relevant information between stakeholders, combining bottom-up expertise with top-down level perspective. In addition, STDA seems to foster – albeit to a lesser extent – insights into strategic decision situations and aligns participating stakeholders towards a joint way forward. These results do not indicate that STDA is superior to other decision modeling methodologies. Methodological comparisons, therefore, could be addressed, as outlined in Chapter 8, in further studies.

Conclusion

Two approaches served to measure the effectiveness of STDA in strategy development contexts. Contributing to the limited knowledge base in relation to the measurement of effectiveness of group decision aids, this chapter has outlined two empirical studies on the process effectiveness of STDA. First, eight technical, 'socio' and result-oriented dimensions, which emerged through expert interviews with strategic decision makers, served to assess the perceived decision process effectiveness of STDA. In comparison to previous studies the approach presented here provided opportunities to compare the organisational intervention to an ideal state on each dimension. Second, by analysing the extent to which preferences of the decision makers for the options under consideration 'converge' towards the modelling results, this chapter introduces a study to assess the alignment effects of STDA.

In addition, this chapter served to analyse the strengths and weaknesses of STDA. Addressing some of the weaknesses, in particular in relation to the insufficient content contribution of the MARA teams, the next chapter serves to present 'Strategy Conferencing' as an approach to further enhance the effectiveness of STDA in strategy development contexts.

Chapter 7 – Strategy Conferencing

7. Strategy Conferencing

Nothing is more difficult than the art of maneuvering for advantageous positions.

Sun Tzu, Chinese General (approx. 300 BC)

A search for direction with a focus on what to do and why is one interpretation of strategy making used in this thesis. As one way of enhancing 'the art of manoeuvring for advantageous position', as Chinese general Sun Tzu framed strategy making on the battlefield, the following chapter serves to outline an approach which aims to further develop socio-technical decision analysis. 'Strategy Conferencing' advocates an enhancement of the 'socio' side in strategy development. This is achieved through the structured integration of the knowledge of domain experts, of the problem-specific experience of decision makers and of the methodological expertise of decision analysts. The approach is a synthesis of some of the lessons drawn from this PhD thesis. The objective of this chapter is to develop a useful approach to increase the effectiveness of socio-technical decision analysis in strategy contexts.

After a more detailed description of the reasons for developing Strategy Conferencing, the following chapter serves to review and evaluate the complementary characteristics of relevant organisational intervention concepts, such as doctor-patient, expert and process consultancy roles. Second, I outline the core idea of the approach as a merger of advisor and process-based intervention characteristics. The last section serves to discuss the process and different elements of Strategy Conferencing.

7.1. The 'Rationale' for Developing Strategy Conferencing

The reason for developing Strategy Conferencing is based on the feedback received from MARA practitioners, the recent call in strategy process literature for the enhancement of the 'socio' side of strategy making, and known deficits in group strategy making. This section outlines these three 'rationales' for the development of Strategy Conferencing.

Rationale I: Call for More 'Socio' Elements in STDA from MARA Decision Makers

As a common feedback theme across the eleven applied research projects carried out within the framework of MARA 2005 and MARA 2006, decision makers suggested

the inclusion of more external expertise in the STDA process. In the case studies for Schering Argentina (Schilling and Schulze-Cleven, 2007) and Deutsche Bahn, in particular, our major clients requested more external experts with industry or functional experience to challenge their views on, for example, criteria scores, criteria weights or potential options to achieve relevant objectives. The qualitative survey evaluation on the weaknesses of STDA in Chapter 5 confirms this call for higher quality data in the STDA process. Of the statements, 46%, for example, referred to the low input data quality, such as highly subjective assessments from the decision makers, data assessment difficulties and the lack of content contributions from the teams.

Rationale II: Call for More 'Socio' Elements in Strategy Development Research

In addition to this feedback from practitioners, the research agenda of strategy theorists points in a similar direction. In order to increase the effectiveness of strategic decisions and bridge the gap between strategy formulation and implementation, researchers have called for a stronger emphasis on the 'socio' side of strategy development.

Lovas and Ghoshal (2000) argue for strategy development as 'guided evolution' driven by 'human and social capital' of a firm. Beer and Eisenstat (2004) call for an effective and honest conversation on business strategy within the organisation. The term 'strategy as a revolution', coined by Hamel (1996), calls for more democratic strategy development by including a variety of stakeholders within the organisation.

Although relatively few studies have focused on the link between strategy formulation and implementation issues, 'socio' factors seem to play an important role in successful strategy implementation (Hutzschenreuter and Kleindienst, 2006). In particular, strategy development as an interactive and feedback-based 'organic' process (Farjoun, 2002), as well as the involvement of key players, especially middle managers (Collier, Fishwick et al., 2004; Dutton, Ashford et al., 1997; Floyd and Wooldridge, 1997; Wooldridge and Floyd, 1990) seems to foster the integration of strategy development and strategy implementation.

As strategic decision making is often performed in groups, known deficits in unaided strategy making played another major role in designing the Strategy Conferencing approach.

Rationale III: Known Deficits in Unaided Strategy Making in Groups

Biases in group decision making, in particular for major decisions, have been the subject of intensive study. Researchers have identified numerous biases in group decision making (for overviews, see Arnott, 2006 or Stangor, 2004). Strategy Conferencing as outlined in this chapter serves partly to 'de-bias' some of these deficiencies. It mainly aims to counteract false consensus seeking and ineffective information processing.

False consensus seeking refers in particular to groupthink (Janis, 1982). Groupthink, usually prevalent in overly homogeneous and cohesive groups, is defined as poorly reasoned decision making due to, for example, the illusion of invulnerability, self censorship and the belief in the inherent morality of the group (Surowiecki, 2004; Turner and Pratkanis, 1998). False consensus seeking also be rooted in the concept of 'social proof' – the tendency of individuals to look for the behaviour of others to validate their own actions (Cialdini, 1993). In particular in the face of uncertainty, people are predisposed to follow the lead of others who are similar to themselves. This has not to be necessarily bad, but can lead to a lack of critical analysis in uncertain situations.

Connected to false consensus seeking is the tendency to irrationally escalate commitment in group decisions (Staw, 1981). In particular, the tendency of decision makers to behave consistently with earlier commitments (Cialdini, 1993), impression management (Caldwell and O'Reilly, 1982) and self-justification and biased information processing (Ross and Staw, 1986), are reasons for the irrational escalation of commitment. In decision conferences these commitment and consistency effects are, for example, in particular visible in the unwillingness of some groups to terminate highly costly but ineffective 'pet' projects.

Ineffective information processing constitutes, besides false consensus, the other side of groupthink. It refers to a lack of processes and methodologies to integrate the preferences and opinions of various stakeholders. These shortcomings can include an incomplete survey of alternatives as well as an insufficient identification of fundamental values (Keeney, 1992) as well as poor information search or selective information processing (Ross and Staw, 1986). Groupthink based on these shortcomings can lead to disastrous group decisions such as the Bay of Pigs decision, the Vietnam War escalation decision or NASA's decision to launch the challenger (Surowiecki, 2004; Turner and Pratkanis, 1998).

A lack of information processing methods can also lead to overconfidence when assessing probabilities (Lichtenstein, Fischhoff et al., 1982). Depending on the difficulty of the task, both groups and individuals are known to systematically over or underestimate their abilities in accurately assessing probabilities (Hoelzl and Rustichini, 2005; Klayman, Soll et al., 1999; Soll, 1996). As strategic decisions usually have to be taken in the face of uncertainty, overconfidence in particular can be another source of ineffective group decisions in strategic contexts.

Deficits in strategic group decision making, the call of the MARA decision makers to include more content knowledge in STDA and the search of strategy researchers for enhanced 'socio' elements in strategy development, constitute the rationale for developing Strategy Conferencing. The next section serves to review organisational intervention modes, which are – when combined – a potential remedy for the three shortcomings in effective strategic decision making outlined above.

7.2. Evaluation of Organisational Intervention Modes

Effective strategic decision making in organisation is closely related to an effective aggregation of preference of organisational members. One way to investigate organisational intervention modes is therefore to study their effects on group aggregation. According to Surowiecki (2004), several conditions have to be met to ensure effective group decisions: first, diversity of opinion, based on private information or a personal interpretation of common facts. Cognitive diversity usually builds on specialisation on specific knowledge, such as content or process expertise. Second, knowledge and judgments should be independent, people's opinions should not mainly depend on the opinion of those around them. Judgmental errors therefore should ideally be correlated as little as possible. Finally, some aggregation mechanism should exist to consistently turn private judgments into a collective decision.

Organisational intervention modes focus on the aspects outlined above to increase the effectiveness of strategy development. We can roughly divide these modes into two advice-based and one process-based intervention mode. Table 7.1 gives an overview of these three approaches.

Advice-based and Process-based Modes Possess Complementary Strengths and Weaknesses

			Contribution to effective strategic decision making through...			
	Concept	Objective	...diversity of opinion	...independence	...aggregation methods	Major drawbacks
Advice-based Interventions (Doctor/Patient and Expert Mode)	Advisor diagnoses a problem and prescribes a solution or provides relevant information for a decision problem	Mainly counteracting false consensus building	+	Increase diversity of opinion based on independent content knowledge	-	Low strategic decision quality due to ineffective integration of the knowledge of organisational members and subsequent lack of implementation commitment
(Purely) Process-based interventions	Process consultant provides methodological knowledge to guide effective decision processes	Mainly counteracting ineffective information aggregation	-	Increase aggregation expertise based on independent methodological knowledge	+	Low strategic decision quality due to anchoring on organisational culture, false consensus seeking and lack of external data

Table 7.1 – Comparison of Advice-based vs. Process-based Organisational Intervention Modes (adopted from Armenakis and Burdg, 1988; Schein, 1999; Surowiecki, 2004)

Advisory Roles

Often pursued by strategic consultants, we can divide advisory roles into doctor/patient modes and expert modes (Schein, 1999). In a doctor/patient mode, an advisor is brought in to check the decision makers' organisation, diagnose a problem and prescribe a solution accordingly. The second role is that of an expert advisor, who sells relevant information to organisations which are unable or unwilling to provide it themselves. The experts in these cases usually develop their expertise through extensive knowledge of relevant facts, based on experience with a large number of similar cases (Armenakis and Burdg, 1988).

Advisory roles are particularly effective to counteract false consensus. Based on their independent domain knowledge, they add cognitive diversity and challenge the tendency of conformity of overly homogeneous groups. A senior industry expert, for example, is able to counteract self-censorship of group members and introduce constructive dissent. These outside views can, in particular, neutralise irrational escalation of commitment by introducing additional incentives to reflect on the consequences of decisions.

Beside such potentials of advisory modes, several drawbacks exist. A common downside is the lack of implementation commitment to the recommended changes due

to ineffective integration of the knowledge of organisational members. In particular, advice based modes can heavily depend on getting accurate diagnostic information, the ability of the advisor to provide appropriate aid, whether the client accepts the conclusions and whether he/she is able to make recommended changes (Schein, 1999).

Process-based Interventions

In contrast to the doctor/patient or the expert mode, process consultancy approaches focus on coordinative and facilitative roles with the aim of developing the decision makers' skills to help themselves (Armenakis and Burdg, 1988). In this mode, content expertise is less relevant and skills in how to guide an effective decision process are prevalent. According to Schein (1999), process consultancy approaches engage decision makers in a generative, double-loop learning approach, as outlined in Chapter 3, to create an effective co-operative relationship.

Process-based interventions can help in particular to counteract ineffective information processing in strategic group decision tasks. Whilst the facilitator cannot increase the diversity of opinions, he can contribute to enhance group preference aggregation. Based on independent methodological knowledge, the facilitator can prevent groupthink tendencies by challenging expressed knowledge from an impartial perspective. Enhancing a more thorough search for alternatives and objectives, a facilitator can thereby create strategic rooms in which group members can fully unfold their diverse cognitive potential. Process-based interventions emphasise the importance of creating commitment to the generated solutions by effectively involving the decision makers in the problem solving process (Phillips, 2006).

A common drawback of these approaches is the difficulty in preventing a group from false consent as the facilitator only contributes to the process, not to the content (Schein, 1999). This applies, in particular, when not all key stakeholders for the decision at hand are involved in the process. In addition, process-based interventions do not aid with the collection of external data, such as benchmark analyses, which might be relevant for strategic decisions.

Taken to the extreme, the process-based interventions, described above, can lead to 'agreement on non-sense', whilst the expert modes can result in 'deep analyses no one cares about'[3]. In this context, strategic consultancies acting as 'doctors' or experts, have frequently been criticised for producing high amounts of decision-irrelevant information and failing to create sufficient commitment to action on the part of the decision makers (Schein, 1999). Process-consultancy approaches, as analysed in this PhD thesis, on the other hand, might generate sufficient 'buy-in' through structured involvement, but may fail to validate decision relevant information through domain experts. The Strategy Conferencing approach, described in the following sections, aims to combine the virtues of these two complementary approaches. An increase in decision effectiveness in strategic decision situations is therefore its main objective.

7.3. Strategy Conferencing: Core Idea

An effective decision process improves the probability of obtaining a high quality decision outcome. The more important the decision, the more relevant effective decision processes are. In strategic decision situations, a structured and thorough analysis of decisions is particularly beneficial. These situations are usually characterised by high complexity, a high degree of uncertainty, multiple stakeholder involvement and an irreversible commitment of resources in the mid-term. Strategy Conferencing, as introduced in the following sections, is designed to increase decision effectiveness in these decision situations. It capitalises on the different levels of expertise of decision makers, advisors and decision analysts. In the socio-technical framework, introduced in Chapter 2, the approach sustains the requisite and interactive modelling component of decision conferencing in order to effectively process information from a greater variety of sources. Figure 7.1 displays the position of the new approach in the socio-technical effectiveness framework as compared with decision conferencing and the advise-based intervention modes. The socio dimension in this case refers to the degree of heterogeneity of information input in a decision – conceptualised as either internal **or** external information based (low heterogeneity) or both internal **and** external information based (high heterogeneity).

[3] These labels are taken from a personal communication with Dr James Matheson, Chairman of SmartOrg, Inc.

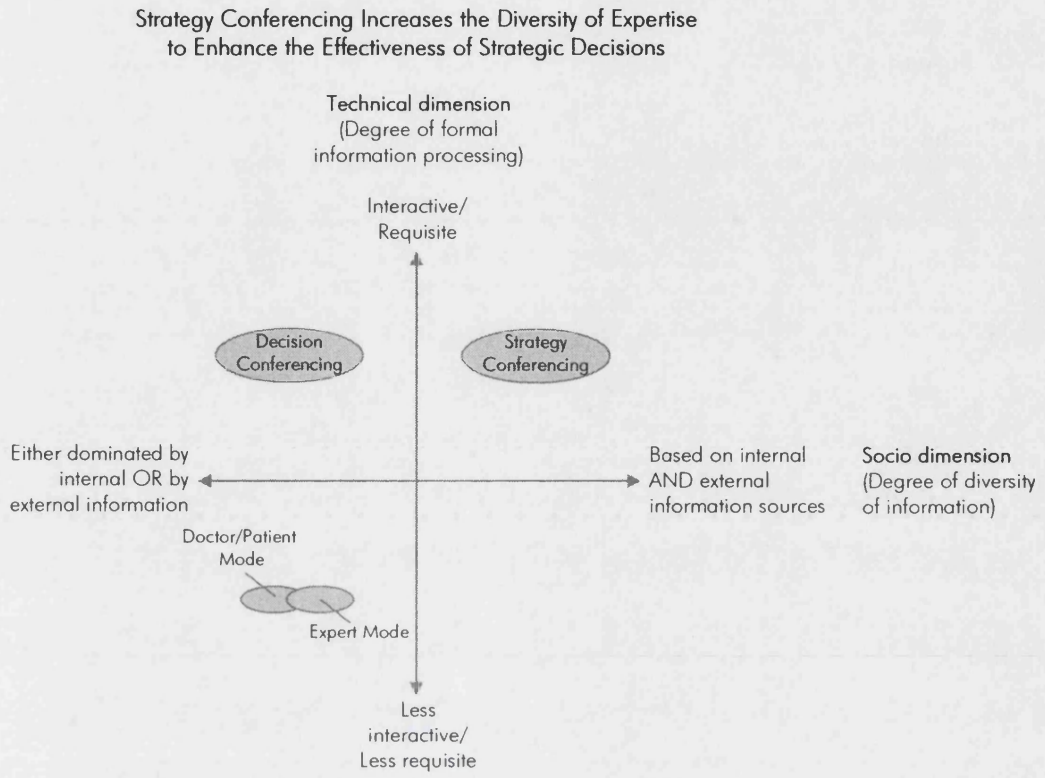

Figure 7.1 – Strategy Conferencing in the Socio-technical Effectiveness Framework

In comparison to the expert and the doctor/patient mode, decision conferencing increases the extent of interactive and requisite modelling. Although the approach integrates a variety of internal stakeholders' opinions, information inflow from external sources is limited. Based on the experience of MARA 2006 and the survey-based analysis, described in Chapter 6, this focus on intra-organisational information input can result in shortcomings related to the gathering of data from the organisation's environment, to culturally-biased information input and therefore insufficient data quality as modelling input. In order to prevent these potential shortcomings, Strategy Conferencing increases the diversity of expertise by including external domain expertise in the process. In addition to this improvement on the 'socio' side, the approach aims to preserve the technical elements of decision conferencing – interactive and requisite decision modelling.

Strategy Conferencing aims, first, to develop a shared understanding of strategic issues faced by the organisation. By including domain experts in the process, the approach, second, aims to counteract false consensus, in particular in very homogeneous groups. The facilitator, third, serves to improve information processing by

facilitating an effective exchange of knowledge between the internal decision makers and the functional or industry experts. Finally, Strategy Conferencing creates commitment to a joint way forward on the strategic issues at hand. The next section outlines the process of Strategy Conferencing in reaching these objectives.

7.4. Strategy Conferencing: Process

Strategy Conferencing integrates the expertise of the decision makers, the external advisors and the decision analysts. The different level of expertise, which these parties add to the process, can be classified according to a content/process and an internal/external dimension, as displayed in Table 7.2. Content expertise thereby relates either to generalised domain knowledge or knowledge related to the specific decision problem. Process expertise includes knowledge about the existing internal decision processes and techniques/methodologies to steer a decision process.

Strategy Conferencing Combines Methodological and Domain-specific Knowledge

	Internal (Decision makers)	External (Advisors / Decision Analysts)
Content Knowledge	Decision makers' domain knowledge of the specific market, the decision problem and the own organisation	Advisors' generalised knowledge on the related domain (expertise on best-practices)
Process Knowledge	Decision makers' knowledge of the existing decision processes of the organisation	Decision analysts' methodological expertise to effectively integrate a variety of stakeholder opinions

Table 7.2 – Knowledge-based Elements of the Strategy Conferencing Approach

Internal Content Knowledge

As a fundamental basis for Strategy Conferencing, the decision makers provide information on the specific decision problem, the specific market and information on the decision context in the organisation, such as culture or 'hidden' agendas. This perspective draws on the resource-based view which focuses on internal capabilities and resources of the organisation, as outlined in Chapter 2 (Barney, 1991; Wernefelt, 1984). Internal content knowledge is often based on decades of experience in a particular market. It can be classified as either fact-based or experience-based

(Lowendahl, Revang et al., 2001). On the fact-based side, knowledge can relate to data from databases of controlling departments or on the experience-based side on implicit knowledge about clients, suppliers or the general market environment. The Strategy Conferencing approach is designed to integrate these different types of knowledge effectively in order to increase the quality of the analysis. In addition, an experienced facilitator is able to rigorously challenge the assertion of internal content knowledge. The approach can thereby serve to 'debias' organisations' inherent inclinations towards traditional ways of thinking and making decisions.

Content Knowledge / External

The advisors' role in the process is to challenge the decision makers' traditional views and to bring in outside state-of-the-art knowledge for similar decision problems. An external advisor usually can draw on knowledge from a large sample size about similar decision problems. This experience can be reflected in industry field expertise, such as pharmaceuticals or logistics, or functional expertise, such as R&D or Marketing. Advisors often use codification strategies (Hansen, Nohria et al., 1999), such as the use of quantitative benchmark analyses or market segmentation studies to create knowledge on best practices within an industry. Complemented by their intuition-based knowledge, senior advisors can contribute to validate and de-bias expert judgments in the process.

Process Knowledge / Internal

In addition to content knowledge, expertise on existing processes in the decision makers' organisation serve to create more useful solutions. Visionary and political elements, as outlined in Chapter 3, reflect this process knowledge. The vision-based element builds on a formalisation of the objectives and goals of an organisation within the framework of the analysis. Not all decision relevant information can be obtained from databases or written documentation. For strategy development to be successful, culture and hidden agendas of the respective strategic decision makers have to be considered. The incorporation of this political element through the structured involvement of a variety of stakeholders can substantially increase the implementation probability of the modelling results (Korsgaard, Schweiger et al., 1995; Wooldridge and Floyd, 1990).

Process Knowledge / External

The decision analysts provide an adaptive and a command-related process element within Strategy Conferencing. On the adaptive side, the decision analysts can provide a learning opportunity for the organisation by establishing Strategy Conferencing as a 'strategic reflection device'. The approach draws on information from the strategic planning processes and feeds back strategic insights into the subsequent planning cycles. A typical example of this 'strategic content learning' occurred in the MARA 2005 Schering Argentina case. The analysis provided an opportunity to reflect on the current marketing strategy of the company. The results could be fed back into the strategy planning cycle in the following year (Schilling and Schulze-Cleven, 2007). As a second learning element, the analysis can enhance the organisation's strategy development processes in the long-term (double loop learning). On the command-based side, Strategy Conferencing provides an effective way to include the opinions of different stakeholders, to help senior management provide directions that others willingly follow (Jacques, 1998).

The left part of Figure 7.2. outlines the dynamic interplay of the four elements of Strategy Conferencing outlined above.

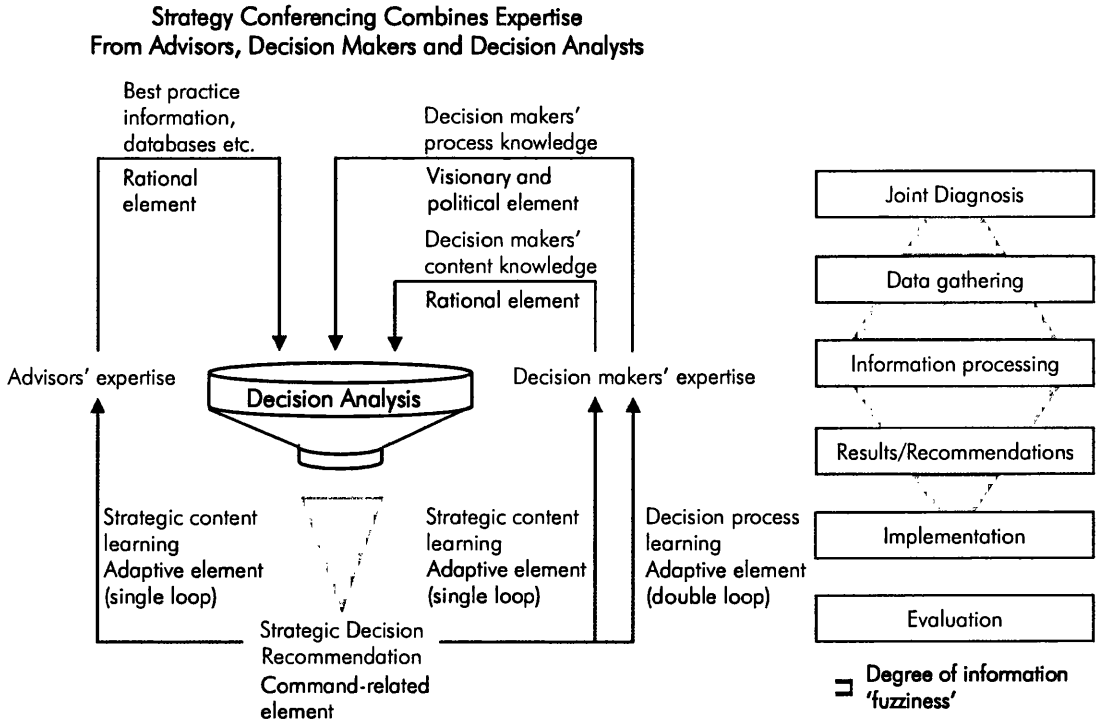

Figure 7.2 – Interaction of Strategy Conferencing Actors (left) and Phases of the Strategy Conferencing Process (right) (Phases Adopted From Armenaski and Burdg, 1988)

Besides the interactions between the different actors in the Strategy Conferencing approach, the right part of Figure 7.2 displays the process steps of Strategy Conferencing. The decision analysts, the decision makers and the advisors engage in several phases (adopted from Armenaski and Burdg, 1988). Similar to the integrated effectiveness model, presented in Chapter 3 (Figure 3.5), the process can be divided in a divergent and a convergent phase, depending on the degree of 'information fuzziness'. After the entry phase, which includes the scouting and contracting of the decision analysts and advisors by the decision makers, the first step of the analysis consists of a joint diagnosis of the decision situation. This is based on the decision makers' specific knowledge of the problem, as well as the analysts' generalised domain knowledge, and is guided by the decision analyst. An initial decision model assists in searching for relevant data, based on internal and/or external sources. In this data gathering and information processing phase, the degree of 'information fuzziness' increases as usually hidden issues and operational problems are discovered. A subsequent series of strategy conferences serve to separate important from unimportant information and to aid in effective information processing (convergent phase). After the development of strategic decision recommendations, follow-up evaluations of the implementation efforts are possible, as suggested by Carper and Bresnick (1989).

Based on this process suggestion for a Strategy Conferencing approach, the core elements of Phillips' description of decision conferencing (Phillips, 2006a) can be altered accordingly. Strategy Conferencing can be seen as a constructive and creative meeting of problem owners and domain experts in order to develop recommendations in strategic decision situations. The approach includes four key elements. First, the attendance of the necessary key players and key experts for the relevant strategic problem. This ensures in particular the availability of relevant and high qualitative data as well as commitment and ownership on the part of the decision makers. Second, a decision analyst separates through impartial process guidance, the integration of content and process knowledge within the process. Third, a decision model, which includes interactive and iterative group processes and on the-spot-modelling, steers the analysis. This modelling process, finally, is designed requisitely. Participants use this just-enough-modelling approach to gather and process information as effectively as possible and to co-ordinate the analysis efforts of decision makers and advisors.

Conclusion

Taking a prescriptive stand, the development of Strategy Conferencing aimed to further strengthen the link between STDA and strategy development. By introducing Strategy Conferencing, the chapter thereby addresses several weaknesses of STDA, as identified through this research. Strategy Conferencing provides an opportunity to further enhance the 'socio' side of STDA, in particular in strategy contexts. We can view the approach as one way to further reduce the gap between strategy implementation and formulation, as well as a possibility of counteracting groupthink phenomena. Strategy Conferencing combines the strengths of the advisor-based approaches – 'industry' or policy-field expertise – and the strengths of the process-based approaches – impartial facilitation to ensure effective information exchange and stakeholder commitment.

Conceptually, Strategy Conferencing builds on data from the strategic planning process of an organisation, but the decision process itself is performed outside of the strategy cycle. The strategic insights can – as is increasingly common – be subsequently integrated into the next strategy planning cycle (Grant, 2003). Strategy Conferencing is therefore another way to further institutionalise STDA in organisations in order to increase the effectiveness of strategic decisions.

Potential weaknesses of the new approach have to be analysed in subsequent applications. One particular danger could be decreasing implementation commitment of the decision makers due to dominant advisors. Research carried out after MARA 2006 has already revealed several application opportunities of the new approach: Strategy Conferencing for target selection in Mergers & Acquisitions, as well as Strategy Conferencing for political strategy development.

Besides the development on the practice side, outlined in this chapter, MARA 2006 and this PhD research have opened several research paths to advance socio-technical decision analysis. These future research possibilities, together with the research objectives 'revisited' and the limitations of this work, constitute the core of the following chapter.

Chapter 8 – Conclusion

8. Conclusion

The real voyage of discovery consists not in seeking new landscapes but in having new eyes.

Marcel Proust

Similar to most PhD research projects, this work was initially a journey into the unknown. The constant alternation between applied analysis in the context of MARA 2006 and empirical research, however, provided an effective working framework to reach solid ground quickly. New insights were numerous and the learning process very valuable. This chapter serves to outline the core results of this research at the interface between decision analysis, strategic management and organisational development.

This conclusion first serves to outline the contributions of the thesis in relation to the research objectives. Second, it summarises possible limitations to the results, followed, third, by new research paths as possible follow-up studies. Finally, the chapter closes the circle of this PhD research by reflecting on the 'meta' topic of this work, introduced in Chapter 1 – the relationship between the success of STDA and the decision analyst's expertise.

8.1. The Research Objectives Revisited

One of the main objectives of this PhD thesis was to analyse and improve STDA in strategy development contexts. I used the six case studies of the applied research project MARA 2006 to assess the decision process effectiveness and group alignment effects of the approach. This empirical research and the literature-based work first aimed to create a conceptual link between socio-technical decision analysis and strategy development processes. Second, it aimed to contribute to enhance approaches to empirically assess the process effectiveness of decision analyses.

'Strategic STDA': Linking STDA with Strategy Development

This research began with the question of whether and how STDA could be linked to strategy development. To answer this question, I took a descriptive frame to connect STDA with strategy development and a prescriptive frame to increase the process effectiveness of STDA for strategic issues.

By integrating several of the most important contributions in the area of strategy development processes over the last decades (Hutzschenreuter and Kleindienst, 2006; Collier, Fishwick et al., 2004; Bailey, Johnson et al., 2000; Mintzberg, Ahlstrand et al., 1998; Hart and Banbury, 1994; Hart, 1992; Nonaka, 1988; Ansoff, 1987; Mintzberg, 1987; Chaffee, 1985; Shrivastava and Grant, 1985; Mintzberg and Waters, 1985; Bourgeois and Brodwin, 1984), this thesis served to develop a simplified taxonomy of five generic strategy development modes: rational, adaptive, command-based, visionary and political. All modes serve to link STDA with the strategy development literature. As outlined in Figure 3.5, effective strategy development using STDA incorporates each of these five perspectives:

- a rational element based on explicit and requisite modelling,
- an adaptive element related to intra-case, inter-case and decision process learning,
- a visionary element to construct and consistently incorporate the goals of an organisation in a strategic decision process,
- a command-related element, as the participative process helps leaders to provide directions that others follow willingly, and
- a (micro) political element, as the process enables key stakeholders to engage in negotiation-like information exchanges.

Based on an integrative effectiveness framework, this work has served to evaluate the strength and weaknesses of STDA in strategy development contexts. The empirical analyses, presented in Chapter 6, have revealed several shortcomings in STDA, in particular on the 'socio' side. The participating decision makers frequently criticised the lack of high quality input data in STDA processes and the lack of external content expertise. As a possible response to such practitioner feedback, whilst also responding to the call by strategy theorists for a stronger emphasis on the communication-oriented 'socio' side (Beer and Eisenstat, 2004; Lovas and Ghoshal, 2000; Hamel, 1996), this PhD research has introduced the concept of 'Strategy Conferencing'. The objective of this prescriptive approach is to increase the effectiveness of STDA in strategy development. It advocates a structured integration of the decision makers' problem

specific expertise, the decision analysts' methodological expertise and the external advisors' domain knowledge (see Figure 7.1 and Figure 7.2).

STDA Effectiveness Studies: Measuring Decision Process Effectiveness and Alignment Effects

In addition to the conceptual link of STDA to strategy development, this research aimed to contribute to the limited literature on assessing the (process) effectiveness of decision analysis. In particular, this thesis has served to develop and apply two decision process effectiveness measures: in the area of perceived decision process effectiveness and in the area of group alignment measurements.

Effectiveness Measure I: Perceived Decision Process Effectiveness

This PhD research has revealed a lack of useful frameworks within which to measure the perceived effectiveness of group decision aids. The few existing frameworks, such as the Competing Value Framework (McCartt and Rohrbaugh, 1989) or the decision quality chain (Matheson and Matheson, 2001; Matheson and Matheson, 1998) proved inapplicable to this research due to vaguely defined information processing dimensions or implicit value statements in the scales applied. The lack of applicable instruments may partly be due to an inadequate integration of practitioners' views on measuring effectiveness. In contrast to the Competing Value Framework, which McCartt and Rohrbaugh (1989) created based on researchers' views, in this thesis, interviews with mostly strategic decision makers served to develop dimensions to assess the effectiveness of decision processes.

We can thereby measure decision process effectiveness on three 'socio', three 'technical' and two result-oriented dimensions. The approach presented in this thesis builds on the assessment of three data points for each effectiveness dimension: the status quo of current strategic decision processes in organisations, the position of the STDA application and a hypothetical ideal state. With this technique, the decision makers could indicate potential dissatisfaction with both the current processes and the new decision processes – a shortcoming of earlier decision effectiveness studies (Chun, 1992).

On the 'socio' side, the participating decision makers have rated STDA as fostering significantly better participation levels, improving the balance of top-down vs.

bottom-up decision making and increasing the quantity of information exchanged between relevant stakeholders in comparison with the status quo. On the technical side, decision makers have assessed STDA as significantly more transparent and comprehensible, as improving the balance of rational vs. intuitive decision making and as enhancing dialogue-orientation and interactivity to a greater extent than existing processes. On the result-oriented dimensions, the STDA process resulted in more creative results which were, however, statistically insignificant, as well as in more strategic insights. Figure 6.4 provides the overall empirical results across all MARA cases, Figure 6.5 presents the results for each individual case.

As the studies, presented in this thesis, assess process-related effectiveness and not consequence-related effectiveness, an analysis of potential respondent biases is essential for the credibility of the results. Due to the special research setting of MARA, the decision makers may, for example, have been biased in favour of STDA. Decision makers who were highly committed to the MARA project, consequently, might have rated STDA as consistently better. We therefore assessed the degree of commitment of each decision maker to the MARA project and compared these ratings with his/her perceived effectiveness. The results, presented in Figure 6.6, show that there is no significant relationship between the degree of commitment and the effectiveness scores. Some decision makers, who were critical of the MARA project, rated STDA as highly effective and some highly committed decision makers assessed STDA as very ineffective. A systematic bias based on individual commitment is therefore improbable. The results of a similar analysis for potential biases of the project sponsors point in the same direction. The decision process effectiveness measures, developed in this work, therefore might be seen as a useful instrument to measure the perceived effectiveness of group decision aids.

Effectiveness Measure II: Alignment Effects

In addition to measuring decision process effectiveness, this work aims to contribute to assess potential alignment effects of STDA. Phillips (2006) and Phillips and Bana e Costa (2007) claim that STDA aligns groups of decision makers to a joint way forward. To my best knowledge, this assertion has not yet been analysed empirically. This thesis aimed to start closing this gap. As outlined in Chapter 6, we can define alignment as the degree to which STDA 'converges' preferences of the decision makers for the

options under consideration towards the modelling results. The alignment study of this research served to assess the individual preferences for the options under consideration before the decision conferences and compared them to the preferences after the interventions, as well as to the results of the decision conference itself. Figure 6.14 presents the overall results of the alignment study. It reveals a significant alignment effect of STDA. The statistically aggregated preferences regarding the options after the decision conference were closer to the decision conference value than the aggregate preferences before the intervention. In addition, the alignment study has shown that statistically aggregated preferences when applying STDA, differ significantly from behaviourally aggregated preferences. STDA cannot therefore be replaced by statistical averaging. The alignment study provided qualified support for useful working hypotheses to further explore alignment effects in group decisions. The new approach to measure alignment effects stimulated further research in relation to aggregation methods in group decisions, as described below.

The analysis of decision process effectiveness and the alignment effects also served to test whether a group of inexperienced decision analysts can apply STDA successfully. I reflect on this 'meta' topic of this PhD in my final conclusion at end of this chapter.

8.2. Limitations of the Results

Despite the contributions to the research objectives, as outlined above, several limitations of the results have to be recognised.

First, strategy development in this work is strictly limited to the generation of strategic insights through the (model-based) analysis of resource allocation decisions. Corporate strategy development or strategy development related to top level policy making in the public sector is not the focus of this analysis. The results can therefore only be generalised to this limited interpretation of strategy making.

Second, this thesis does not cover consequence-related effectiveness assessments, such as the link between strategic decisions and organisational performance ('strong effectiveness' according to Clemen, 2006). An analysis of the final consequences of the STDA applications on, for example, profit of our partner organisations, would not have been possible due to other variables which influence the bottom-line. External market effects and other internal decisions taken simultaneously, for example, would have made

it almost impossible to establish a causal link between the STDA recommendations and their consequences. In addition, the necessary time frame to conduct this kind of analysis would have been out of the scope of this research. The focus of this work was therefore on perceived effectiveness, assessed by the decision makers. One can therefore generalise the results only to this more subjective definition of effectiveness.

Third, although the applied research character of MARA resulted in higher external validity in comparison to a laboratory setting (Bonoma, 1985), the field study setting led to several other limitations. The random sampling of the projects, common in classical experiments, was not possible. In addition, we were not able to establish a counterfactual, for example, to compare STDA applications to unaided decisions situations or other kinds of organisational interventions. For these kinds of comparisons, a larger sample of similar cases with similar decision makers would have to be analysed, which is very difficult to find in a field setting.

Finally, the cultural context of the interventions must be considered when evaluating the findings of this thesis. The effectiveness results, observed in this research could, for example, be attributed to the 'open' organisational cultures of the MARA partner organisations or – on a broader scope – to the tendency for certain sectors in Western society to strive for effective and transparent decisions.

8.3. Research in Progress

Besides the contributions to the research objectives, outlined above, this thesis and the MARA project stimulated further research work in progress.

In addition to a publication of the marketing budgeting case study for Schering Argentina, carried out during MARA 2005 (Schilling and Schulze-Cleven, 2007), further research work includes: the publication of all MARA 2006 case studies, a conceptual work at the interface of decision analysis and strategy development in the public sector and the publication of the effectiveness framework with the related effectiveness studies. Table 8.1 displays an overview of this research work in progress.

In addition to this research, MARA 2005 and MARA 2006 led to the creation of a foundation in Argentina, the 'Fundación MARA' and a research institute in Germany, the

'Decision Institute'[4]. The objective of these organisations is to contribute to the advancement of decision analysis in the two countries.

The MARA Projects and This Thesis Stimulated Further Research Work

#	Area	Description	Information Source	Possible Journals
1	Decision Analysis and Effectiveness Measurements	Introduction of a new decision process measurement instrument in strategic contexts, including the MARA effectiveness study results	Based on the decision process effectiveness study	*Decision Analysis*
2	Decision Analysis and Strategy Development in the Public Management	Evaluation of different public resource allocation mechanisms, including the development of an STDA-based system to aid with strategy development in the public sector	Based on the MARA 2006 case 'Prioritisation of Infrastructure Funding'	*Organization Science* or *Decision Analysis*
3	Applied Decision Analysis	Publication of the practice-relevant field work in the framework of MARA 2005 and MARA 2006	Based on the case study work of MARA 2005 & MARA 2006	*Interfaces*

Table 8.1 – Research Work in Progress Based on the Results of the Applied Research Projects MARA 2005 and MARA 2006

In addition to the current research in progress, as outlined above, this PhD research has revealed several interesting future research paths, which I outline in the following sections.

8.4. Future Research

The following three future research paths reflect the different foci of this research. Stimulated by the alignment research, an evaluation study, first, could serve to analyse and compare different aggregation methods in group decision contexts. Second, I suggest a factor analytic confirmation study, i.e. a modification of the decision process effectiveness framework, based on a survey with a large sample size. Third, taking the research on the effectiveness of decision processes one step further, I outline a possible

[4] For more information on the Fundación MARA, see www.mara.org.ar. For more information on the Decision Institute, see www.decisioninstitute.eu.

study on the outcome-related effectiveness ('strong' effectiveness) of STDA applications in simulation environments.

Evaluation Study on the Quality of Aggregation Methods in Group Decisions

The alignment study, outlined in Chapter 6, has implicitly served to compare two preference aggregation methods for group decisions. Judgments have been aggregated statistically before and after the decision conference, as well as behaviourally during the decision conference. This research idea has contributed to the development of a follow-up study, which Cornelius Schaub, a co-initiator of MARA, is currently pursuing in his PhD research (Schaub, 2007). The core idea of his comparative analysis is to evaluate the quality of different aggregation methodologies in group decisions. The fundamental objective is to increase the quality of expert judgments in groups decisions.

In this follow-up study, decision makers' scores on different criteria will be assessed before and after the interventions. This more detailed study setting allows for a greater analysis of the effectiveness of different aggregation modes. Several criteria, related to the process quality and attitudinal criteria (Timmermans and Vlek, 1996), will serve to evaluate the quality of different aggregation modes. The study aims to also include laboratory experiments to analyse outcomes rather than the process of decisions.

Factor-analytic Modification of the Decision Process Effectiveness Instrument

Besides stimulating follow-up studies in the area of group aggregation methods, the decision process effectiveness framework, as outlined in Chapter 3, aims to add a useful framework to measure the effectiveness of group decision aids. The resulting approach, however, rests on a relatively small number of expert interviews. As a logical next step, this instrument could be verified and possibly modified with a factor-analytic approach. A questionnaire, including different statements related to the decision process effectiveness dimensions and possibly some new dimensions, could be designed. A large sample size with a subsequent factor analysis could serve to evaluate factor loadings of the different dimensions and to increase the validity of the instrument.

Outcome-related Effectiveness Study in Simulation Environments

The decision effectiveness study, presented in this thesis, has evaluated STDA on process-related criteria. Hence, the participating decision makers have assessed the characteristics of the decision process itself, rather than the actual consequences of the decisions taken. Outcome-related, i.e. 'strongly effective' measurements (Timmermans and Vlek, 1996; Clemen, 2006) constitute an even more valuable effectiveness indicator, in particular due to a higher degree of objectivity when evaluating results. As longitudinal studies to observe the actual consequences in the field are often expensive and time consuming, one could test the effectiveness of STDA, as suggested by Clemen (2006), in a simulation environment. Negotiation simulations, for example, might constitute such a suitable research environment. In a collective bargaining simulation, as developed, for example, by Schilling and Mulford (2006), a management and a union party have to jointly agree on a multiple-issue contract. At least two studies to test the effectiveness of a STDA-based negotiation aids are imaginable in this context.

A facilitator could assist both negotiation parties simultaneously to reach a mutually acceptable solution using an STDA-based approach (symmetric-prescriptive approach, according to Raiffa, Richardson et al., 2002; Raiffa, 1982). Whilst the parties would use the STDA process in the experimental condition, they would solve the bargaining situation unaided in the control group. Schilling and Mulford (2007) outline a corresponding socio-technical mediation process. The joint gains of both negotiation parties could serve as independent variables. The hypothesis is that the negotiation parties, which use the STDA-based negotiation process, obtain higher joint gains than the unassisted parties.

In the second study, only one of the negotiation parties would use the STDA-based process to model different contract values, including the estimation of the other parties' preferences. In this asymmetric-prescriptive condition (Raiffa, Richardson et al., 2002; Raiffa, 1982), in the experimental group, one party would obtain STDA-based process assistance, whilst, in the control group, both parties would solve the bargaining situation unassisted. The individual gains of the single parties could serve as independent variables in this case. The hypothesis is that the negotiation party which uses the STDA-based process obtains a higher individual gain.

In addition to negotiation simulations, business simulations might serve as another suitable environment to test the outcome-related effectiveness of STDA. Due to their high

degree of 'fidelity' – i.e. the level of realism presented to the simulation participant (Feinstein and Cannon, 2002) – students or expert participants can usually relate well to these kinds of simulations. Behavioural simulations with a high degree of group interaction, as reviewed by Summers (2004), might in particular prove useful to testing the effectiveness of group decision support systems, such as STDA.

8.5. Final Conclusion

A discussion with a German Professor in Psychology on the applicability and usefulness of decision analysis was one of my initial inspirations for pursuing the research reported in this thesis. Charisma and guru-like expertise were – according to his view – the key if not the essential ingredients for successful decision analyses. This research showed that high-level methodological expertise is not a prerequisite for successful decision analyses. The effective application of STDA in eleven case studies during MARA 2005 and MARA 2006 showed that STDA could be applied successfully by relatively inexperienced decision analysts.

Despite the fact that the MARA decision makers perceived STDA as effective, the approach can certainly not be regarded as suitable for every complex decision. Full-scale decision analyses can often be inappropriate for personal decisions, for example decisions about medical treatment, genetic testing or financial investments (Jungermann and Fischer, 2005; Jungermann, 1999). In those situations, the costs of an analysis both in time and money usually outweigh the benefits. Strategic decisions in organisations are different as the benefits of thorough analyses can be substantial. In an organisations' everyday work, however, 'time limited' operational issues often seem to be more important than strategic, 'unlimited' ones. Consequently, rule-of-thumb approaches based on misplaced confidence in global judgments (Hastie and Dawes, 2001) sometimes dominate strategic thinking.

STDA can contribute to better strategic decision making both by directing appropriate attention to the thorough preparation of strategic decisions and by offering an effective way for decomposed judgments. In particular, when the future of an organisation and the professional lives of its members are at stake, hard and occasionally time consuming deliberative thinking with analytical methodologies can provide invaluable help to avoid costly, ineffective and potentially disastrous decision making.

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ANNEX

Annex 1: Interview Guideline

Expert Interview Guideline

Concepts of Strategy

- What is your personal definition of strategy?
- Please think of an example of a successful strategy from your work context. What are its characteristics?
- Please think of an example of an unsuccessful strategy from your work context. What are its characteristics?

Elements of Strategy Development Processes

- What is the outline of the annual strategic planning process in your organisation?
- What are the goals of the specific stages?
- What are its strengths and weaknesses?

Effective Strategy Development Processes

- Please think of one recent strategic decision. In which stages of the strategy development process did you make this decision?
- What is an effective strategy development process? What are its characteristics? (Process & Results)
- How can an effective process be differentiated from an ineffective one?
- On which dimensions is it possible to differentiate strategy development processes?
- If you think of a successful strategy: how did you develop it?
- If you think of an unsuccessful strategy: how did you develop it?
- Where are currently impediments to effective strategy development?
- Greenfield approach:

If you had to close down the company, fire the staff, hire new staff and re-design all the processes: what would the new strategy development process look like?

After interviewee mentioned participative aspects in strategy development: What is effective participation in strategy development? How can it be achieved?

Annex 2: The Effectiveness Questionnaire

Your name:
Job title:
Distance of your position to the CEO
(in number of hierarchies):

Organisation:
How long have you been in this position:

In the following sections, we would like to ask you to evaluate the decision analysis carried out within the framework of MARA 2006. We are interested in your opinion - there is no right or wrong answer in this questionnaire. Your responses will be kept strictly confidential. For each of the eight following questions, we ask you to indicate three ratings:

- How do you **rate** the **decision analysis** carried out by the MARA team ('MARA')?
- How should **problems similar to the one** approached by the MARA team **ideally be solved** in your organisation ('Ideal')?
- How would the decision problem at hand or **problems similar to the one** approached by the MARA team **have ordinarily been solved** with the **existing processes/methods** in your organisation ('Status Quo')?

For example, suppose the question concerned the speed with which problems are solved in your organisation. You would be asked these three questions:

A. **MARA**: How quickly did the MARA decision analysis produce a result? (Please indicate your rating by writing an "M" at the appropriate point on the scale below.)
B. **Ideal**: How quickly should problems similar to the one approached by the MARA team ideally be solved in your organisation? (Please mark this ideal state with an "I" at the appropriate point on the scale below.)
C. **Status Quo**: How quickly would the decision problem at hand or similar problems have been solved with existing processes or methods in your organisation? (Please mark this with an "SQ" at the appropriate point on the scale below.)

Very quickly	1	2	3	4	5	6	7	Very slowly

Now please turn the page and answer the eight questions.

Annex

1. **Extent of participation by people in your organisation in the problem solving process**

   A. **MARA**: How participatory do you rate the MARA decision analysis? (Please indicate your answer by writing an "M" at the appropriate point on the scale below.)
   B. **Ideal**: How participatory should problems similar to the one approached by the MARA team ideally be solved in your organisation? (Please mark this ideal state with 'I' at the appropriate point on the scale below.)
   C. **Status Quo**: How participatory would the decision problem at hand or similar problems have been solved with the existing processes/methods (Please mark this with 'SQ' at the appropriate point on the scale below.)

Not very participatory, including few opinions within the organisation	1	2	3	4	5	6	7	Very participatory, including a variety of opinions within the organisation

2. **Extent of top-down vs. bottom-up influence in your organisation during problem-solving processes**

   A. **MARA**: How do you rate the MARA decision analysis in terms of bottom-up vs. top-down influence? ('M')
   B. **Ideal**: How should problems similar to the one approached by the MARA team be ideally solved in your organisation in terms of bottom-up vs. top-down influence? ('I')
   C. **Status Quo**: With how much bottom-up/top-down influence would the decision problem at hand or similar problems have been solved with the existing processes/methods? ('SQ')

Strongly top-down driven (mainly decided by top-level management)	1	2	3	4	5	6	7	Strongly 'bottom-up' (including middle management influenced)

3. **Extent of transparency and comprehensibility**

   A. **MARA**: How do you rate the transparency and comprehensibility of the MARA decision analysis? ('M')?
   B. **Ideal**: With how much transparency and comprehensibility should problems similar to the one approached by the MARA team ideally be managed in your organisation? ('I')
   C. **Status Quo**: How transparently and comprehensibly would the decision problem at hand or similar problems be solved with the existing processes/methods? ('SQ')

Complex, not very transparent and comprehensible	1	2	3	4	5	6	7	Highly transparent and comprehensible

4. Contribution of rational analysis and intuitive judgement

A. **MARA**: How do you rate the MARA decision analysis in terms of rational analysis vs. intuitive judgement? ('M')
B. **Ideal**: How should problems similar to the one approached by the MARA team ideally be solved in your organisation in terms of rational analysis vs. intuitive judgment? ('I')
C. **Status Quo**: How rationally analysed vs. intuitively judged would the decision problem at hand or similar problems be solved with the existing processes/methods? ('SQ')

Mostly based on intuitive decisionmaking	1	2	3	4	5	6	7	Mostly based on rational analysis

5. Extent to which creativity or traditional ideas contribute to problem-solving

A. **MARA**: How do you rate the MARA decision analysis in terms of simulating creativity?('M')
B. **Ideal**: How should problems similar to the one approached by the MARA team ideally be solved in your organisation in terms of creativity-stimulation vs. based on established' ideas? ('I')
C. **Status Quo**: How creatively vs. 'established' would the decision problem at hand or similar problems be solved with the existing processes/methods? ('SQ')

Less creativity-simulating, more based on 'established' ideas	1	2	3	4	5	6	7	Highly creativity stimulating, less based on 'established' ideas

6. Extent of interactivity and dialogue-orientation ('Quality' of information flow)

A. **MARA**: How interactive and dialogue-oriented do you rate the MARA decision analysis? ('M')
B. **Ideal**: How interactively and dialogue-oriented should problems similar to the one the approached by MARA team ideally be solved in your organisation? ('I')
C. **Status Quo**: How interactively and dialogue-oriented would the decision problem at hand or similar problems be solved with the existing processes/methods? ('SQ')

Less interactive and less dialogue-oriented	1	2	3	4	5	6	7	Interactive and dialogue-oriented

7. Extent of information exchange (Quantity of information flow between different stakeholders)

A. **MARA:** How do you rate the MARA decision analysis in terms of facilitating information exchange between different stakeholders? ('M')
B. **Ideal:** **Ideally,** how much information exchange between different stakeholders should occur when solving problems similar to the one approached by the MARA team? ('I')
C. **Status Quo:** How much information exchange would occur in the decision making process with the existing processes/methods for the problem at hand or similar problems? ('SQ')

Little exchange of information	1	2	3	4	5	6	7	Extensive exchange of information

8. Extent of strategic insights

A. **MARA:** How do you rate the MARA decision analysis in terms of creating strategic insights which can be used for follow-up or different projects? ('M')
B. **Ideal:** To what extent should decision processes for problems similar to the one approached by the MARA team create strategic insights rather than strictly problem-related results? ('I')
C. **Status Quo:** To what extent would existing processes/methods create strategic insights for the problem at hand or similar problems? ('SQ')

Somewhat less strategic insights	1	2	3	4	5	6	7	More strategic insights

Additional questions

9. In your opinion, what are the core strengths of the decision analysis the MARA team conducted?
10. What are, in your opinion, the core weaknesses of the decision analysis the MARA team conducted?
11. How should we improve the method?
12. In which ways (if any) did you benefit from the decision analysis?
13. How did the decision analysis change your view of the problem at hand?
14. Decision analyses are somewhat time consuming. How would you rate the process in terms of value of analysis vs. time spent (efficiency)?

High time efficient (relatively high value analysis for the time spent)	11	22	33	44	55	66	87	Low time efficient (relatively low value analysis for the time spent)

15. Would you recommend a similar decision-analytic process in the future?
☐ Yes ☐ No

Many thanks for your contribution to the MARA 2006 research.

Annex 3: Content Analysis to Develop the Effectiveness Dimensions – Technical Dimensions

		Technical Dimensions					
#	Organisation	The extent of transparency and comprehensibility of the process		The extent of rational analysis vs. intuitive judgment in the process		The extent of interactivity and dialogue-orientation of the processes (Quality of information exchange)	
		Citation(s)	#	Citation(s)	#	Citation(s)	#
1	Siemens						
2	Siemens	"The lack of transparency in strategic planning processes is a common problem."	2				
3	Siemens					"Strategic planning lacks interactive and qualitative discussions - more qualitative interactions are necessary."	4
4	Siemens	"Strategy development processes need to be designed transparently so that the decision-makers can process information accordingly."	4	"A problem is how a strategy development processes can be designed so that rationally the relevant information from the environment are selected".	1	"The management needs to thoroughly discuss the premises in the strategy planning process."	1
5	Schering	"Strategy development processes need to be comprehensible, homogenous and consistent."	1			"Strategy development involves concentration on the essence. It should not be overly bureaucratic"	1
6	Schering	"Problem: The whole process of portfolio strategy creation can be very untransparent and politically driven."	2	"The process encourages some people not to be really objective."	1	"A fruitful communication between project team and management should be enhanced during strategy development."	1
7	Deutsche Bahn	"Good comprehensability and results that can be communicated are very important."	2	"If you invite the right people to the table, the strategy will be more rational."	2	"We need interaction - an exchange of views in strategy development processes."	1
8	Deutsche Bahn	"Transparency in the process is very important for the employees."	3			"Communication, communication, communication on all levels to increase the buy-in to strategic decisions."	2
9	Deutsche Bahn					"Strategy development is often based too much on calendars, rather than interaction."	1
10	Deutsche Bahn	"Effective strategy development is connected with simple and comprehensible communication."	5			"Internal communication is essential in strategy development."	2
11	BASF					"Constructive dialogues and fights are necessary in strategy development."	1
12	BASF			"Both approaches need to be involved in strategy development: rational and incremental."	2	"We need more interaction between the top of the public administration and the lower levels."	1
13	The Boston Consulting Group	"In strategy development, goals need to be clear and unambiguous."	3			"The quality of strategy development processes is often low."	1
Overall number of concepts mentioned		22		6		16	

Annex 4: Content Analysis to Develop the Effectiveness Dimensions – 'Socio'-Dimensions

		Socio Dimensions					
#	Organisation	The extent of participation by people in the organization in the problem-solving process		Extent of top-down vs. bottom-up influence in the organization during problem-solving processes		The extent of information exchange between different stakeholders (Quantity of information exchange)	
		Citation(s)	#	Citation(s)	#	Citation(s)	#
1	Siemens			"Communication from middle management to top-management is essential in strategy development."	2		
2	Siemens	"An effective strategy development process includes relevant stakeholders in the organization. The advantage is a better implementation of the results."	3	"Effective strategy development results from an iterative processes between top-management expertise and bottom-up knowledge."	2	"Diversity of opinion is essential in strategy development processes."	2
3	Siemens			"The is a need for a better communication between front line and the headquarters in strategy development."	2		
4	Siemens	"Those who are responsible for executing a strategy need to be involved in the strategy-making process."	4	"A strategy which is not co-developed by subordinate managers has a lower probability of success."	1	"It is essential to get information from a variety of sources and to discuss it in strategy development."	3
5	Schering			"Good strategy development processes include an effective flow of information between the hierarchies."	2		
6	Schering	"Not enough participation at all in strategy development."	1				
7	Deutsche Bahn	You should bring the right people in the organisation to the table when you develop strategies.'	4				
8	Deutsche Bahn	'You need to involve people from the front-line when developing strategy."	2				
9	Deutsche Bahn			"In strategy development you need to delegate some power to the bottom."	1		
10	Deutsche Bahn	"Participation is important since goals should be realistic and create commitment."	1	"A clear strategic direction is important - but it does not only work top-down."	3		
11	BASF	"As a resoponsible manager you should have all people involved."	3			"If participants in strategic planning processes don't have all relevant information, you can lose time."	1
12	BASF	"As much participation as possible is necessary when the strategic changes have to be supported by many in the organisation."	1				
13	The Boston Consulting Group	"Involvement of people in the strategy development process is important."	1	"The interface between strategic vision and operational knowledge is often managed insufficiently."	3		
Overall number of concepts mentioned		20		16		6	

Annex 5: Content Analysis to Develop the Effectiveness Dimensions – Results Dimensions

		Result-oriented Dimensions			
#	Organisation	The extent to which creativity or more traditional ideas are stimulated by the process		The extent of strategic insights created through the process	
		Citation(s)	#	Citation(s)	#
1	Siemens				
2	Siemens				
3	Siemens				
4	Siemens	The strategy development process needs to create creative ideas, in particular in technology-driven areas.'	1		
5	Schering	"Strategy development processes should stimulate a free exchange of new ideas."	1		
6	Schering	"In strategy development, people do not think sufficiently out-of-the box."	1	"In strategy development people think too operationally - they never get into a helicopter to see the whole picture - everybody who likes strategy leaves."	2
7	Deutsche Bahn				
8	Deutsche Bahn	"The process should be more creative - you need to stimulate new ideas through the involvement of heterogenous opinions."	2		
9	Deutsche Bahn			"The focus of strategy development is too much on operative things."	1
10	Deutsche Bahn	"It is important to think openly in the process."	1		
11	BASF	"Strategy development should be small and creative - guided by people who allow for this."	1		
12	BASF	"More creativity is important."	1	"In many organizations processes are unfortunately designed so that the things with deadlines push away the things without deadlines - the strategic questions are not considered accordingly."	1
13	The Boston Consulting Group	"The strategy development process needs to generate innovations."	1		
Overall number of concepts mentioned		9		4	

Annex 6: Data Decision Process Effectiveness Study

Decision maker	Commitment	1. General participation			2. Top-down vs. bottom-up			3. Transparency and comprehensibility		
		Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)
Less committed (x = 2-4.67) N=14										
Venbert	2.00	5	2	6	5	4	6	7	3	6
Knigge	2.75	6	5	3	4	5	2	6	6	2
Gascha	3.00	7	1	3	4	2	1	7	1	4
Sumpf	3.25	5	6	4	3	3	2	6	5	4
Sumpf	3.25	5	5	4	4	3	2	6	4	4
Grimm	3.33	6	4	4	6	6	4	7	6	3
Knauer	3.33	4	6	3	3	1	2	2	3	5
Wenzel	3.33	5	7	2	4	6	2	7	5	4
Landegl	3.60	5	6	2	4	4	3	7	4	2
Damm	4.00	6	4	2	4	3	2	7	5	4
Erbert	4.17	3	4	2	3	4	2	7	5	4
Erbert	4.17	3	4	2	3	4	2	7	5	4
Hönninghausen	4.33	6	7	4	4	4	3	6	5	3
Pielke	4.67	7	6	6	4	7	6	7	6	5
Average		5.21	4.79	3.36	3.93	4.00	2.79	6.36	4.50	3.86
Moderately committed (x = 4.83-5.6) N=14										
		Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)
Bentlage	4.83	3.5	6	2	4	5	2	6	6	2
Leuffen	5.00	7	7	5	4	5	3	6	5	4
Bussert	5.00	4	6	3	4	5	3	3	2	4
Reh	5.00	5	6	5	3	2	2	6	4	3
Würfl	5.25	4	5	3	3	3	3	6	4	4
Winkelmann	5.33	4	4	3	6	5	4	7	6	2
Wanka	5.33	4	4	3	6	5	4	7	6	2
Eymer	5.50	1	6	5	3	6	2	6	4	2
Kneissl	5.50	4	5	2	5	4	6	1	4	5
Kneissl	5.50	4	5	3	4	3	2	7	4	4
Hofmann	5.60	4	5	3	3	5	5	5	6	2
Bürgler	5.60	6	6	2	5	6	3	6	5	1
Einfeldt	5.60	6	6	3	4	6	2	6	5	5
Einfeldt	5.60	6	6	2	4	5	3	7	6	5
Average		4.46	5.50	3.14	4.14	4.64	3.14	5.64	4.79	3.21
Highly committed (x = 5.67-7) N=16										
		Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)
Waller	5.67	5	4	2	4	5	7	6	5	2
Hafl	5.67	6	6	3	6	6	4	6	3	4
Stähr	5.67	6	6	5	6	6	3	6	7	5
Grawert	6.00	5	5	3	5	5	4	6	4	3
Alling	6.00	7	6	3	5	6	7	6	5	2
Lassak	6.00	4	6	3	4	5	3	5	6	4
Heinrich	6.17	6	5	4	5	3	3			
Stein	6.33	6	7	5	5	7	4	5	6	4
Tränkle	6.50	6	4	3	4	4	6	7	4	4

Annex 6: Data Decision Process Effectiveness Study (cont.)

Decision maker	Commitment	4. Rational-based vs. intuitive-based			5. Creativity			6. Quality of information exchange		
		Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)	Ideal(I)	MAR A(M)	Status Quo (S Q)
Less committed (x = 2-4.67) N=14										
Vanbert	2.00	6	2	5	6	2	4	7	6	5
Knigge	2.75	5	4	3	4	4	4	5	6	2
Gascha	3.00	5	1	3	5	1	3	6	4	4
Sumpf	3.25	6	4	4	6	5	4	7	6	5
Sumpf	3.25	6	5	3	6	6	4	6	5	3
Grimm	3.33	6	7	3	5	6	3	6	5	2
Knauer	3.33	7	5	6	6	2	4	5	4	5
Wenzel	3.33	5	7	5	4	4	4	7	7	2
Landegl	3.60	7	5	2	5	5	1	5	6	2
Damm	4.00	5	4	6	7	2	1	7	7	3
Erbert	4.17	6	4	3	5	4	3	5	6	4
Erbert	4.17	6	4	3	5	4	3	5	6	4
Hünninghausen	4.33	6	6	4	6	5	4	6	6	4
Pieske	4.67	7	7	7		4	3	7	4	3
Average		5.93	4.64	4.07	5.38	3.86	3.21	6.00	5.57	3.43
Moderately committed (x = 4.83-5.6) N=14										
Bentlage	4.83	6	6	3	6	5	4	6	7	4
Leuffen	5.00	4	3	5	7	7	4	7	7	4
Bussert	5.00	4	5		6	5	4	5	5	3
Reh	5.00	5	6	4	5	4	3	6	6	4
Würfl	5.25	5	6	4	6	3	5	6	6	4
Winkelmann	5.33	6	7	4	4	5	2	6	6	2
Wanka	5.33	6	7	4	4	5	2	6	6	2
Eymer	5.50	6	5	4	5	2	3	6	6	4
Kneissl	5.50	4	6	3	6	4	4	3	2	5
Kneissl	5.50	4	3	5	6	4	3	6	6	4
Hofmann	5.60	4	6	7	5	6	1	4	6	1
Bürgler	5.60	5	4	2	4	5	2	5	6	2
Einfeldt	5.60	4	5	4	6	2	4	5	7	4
Einfeldt	5.60	5	5	5	5	3	2	5	6	2
Average		4.86	5.29	4.15	5.36	4.29	3.07	5.43	5.86	3.21
Highly committed (x = 5.67-7) N=16										
Walter	5.67	4	3	6	6	6	1	7	6	2
Huff	5.67	5	6	3	6	2	4	6	6	4
Stöhr	5.67	5	5	5	6	5	2	5	7	2
Gravert	6.00	6	4	3	5	4	3	5	4	2
Afting	6.00	7	5	3	6	3	3	6	6	3
Lassak	6.00	4	5	3	4	3	3	5	6	4
Heinrich	6.17	5	5	5				6	5	4
Stein	6.33	5	7	4	4	6	3	5	6	4
Tränkle	6.50	6	4	4	7	5	4	6	4	3

Annex 6: Data Decision Process Effectiveness Study (cont.)

Decision maker	Commitment	7. Quantity of information exchange			8. Strategic insights		
		Ideal(I)	MARA(M)	Status Quo (SQ)	Ideal(I)	MARA(M)	Status Quo (SQ)
Less committed (x=2-4.67) N=14							
Venbert	2.00	7	3	6	7	3	5
Knigge	2.75	5	6	4	6	6	5
Gesche	3.00	7	4	3	7	1	3
Sumpf	3.25	7	6	5	7	5	4
Sumpf	3.25	6	5	3	6	4	4
Grimm	3.33	6	5	2			
Knauer	3.33	5	2	4	7	4	4
Wenzel	3.33	5	7	4	7	4	5
Landegl	3.60	7	5	3	7	4	1
Damm	4.00	7	6	4	6	5	4
Erbert	4.17	7	4	5	7	4	3
Erbert	4.17	7	4	5	7	4	3
Hönninghausen	4.33	6	6	4	7	6	4
Piefke	4.67	7	7	3	7	4	4
Average		**6.36**	**5.00**	**3.93**	**6.77**	**4.15**	**3.77**
Moderately committed (x=4.83-5.6) N=14							
Bentlage	4.83	6	7	5	4	4	4
Leuffen	5.00	7	6	3	7	6	4
Bussert	5.00	5	5	3	5	4	
Reh	5.00	5	6	4	5	4	4
Würfl	5.25	6	6	4	6	4	4
Winkelmann	5.33	6	6	2	4	5	3
Wanka	5.33	6	6	2	4	5	3
Eymer	5.50	6	4	3	7	6	3
Kneissl	5.50	2	3	5	6	4	4
Kneissl	5.50	6	4	4	6	5	4
Hofmann	5.60	6	4	2	6	5	3
Bürgler	5.60	5	6	2	6	6	3
Einfeldt	5.60	6	7	5	5	2	3
Einfeldt	5.60	7	6	6	4	1	4
Average		**5.64**	**5.43**	**3.57**	**5.36**	**4.36**	**3.54**
Highly committed (x=5.67-7) N=16							
Walter	5.67	7	7	2	7	7	2
Huff	5.67	6	5	2	6	5	3
Stähr	5.67	5	6	2	6	4	3
Gravert	6.00	6	3	4	5	3	2
Alting	6.00	6	6	3	6	3	2
Lassak	6.00	7	6	4	7	5	5
Heinrich	6.17	5	4	4	6	5	2
Stein	6.33	5	6	4	5	6	4
Tränkle	6.50	6	5	5	7	4	4

Annex 7: Qualitative Survey Results – Strengths of Socio-technical Decision Analysis

Criteria	Interactive and dialogue-oriented information exchange	High participation and involvement in general	Effective transfer of data and opinions	Systematic, structured analysis	More transparent and comprehensible decision process	Strategic focus (beyond day-to-day business)	Flexibility
Statements:							
Partizipativer Dialog.	1						
Die Strukturierung.				1			
Das Hinterfragen von „Selbstverständlichkeiten" und das auf einen gemeinsamen Nenner bringen von unterschiedlichen Ansätzen.			1				
Die Unterstützung von bewussten Entscheidungen.				1			
Strukturierte, systematische Betrachtung weicher Entscheidungsfaktoren.				1			
Partizipative Vorgehensweise.		1					
Transparente Vorgehensweise.					1		
Wertvoller Prozess, insbesondere die strukturierte Aufbereitung zur Entscheidungsfindung.				1			
Dialog, Kommunikation, Definition von Bewertungskriterien und Ausgangsbedingungen.	1						
Aufbereitung Ergebnisse - Transparenz, Sensitivitätsanalysen, Moderation durch Team als Makler hilfreich.					1		
Dialogfördernd, Metaebene in Diskussion und Auswertung erreichbar.	1						
Kein „Verzetteln im Operativen".						1	
Partizipativer Dialog.	1						
Sich aus dem Tagesgeschäft zu befreien und sich des eigenen Maßnahmenportfolios bewusst zu werden.						1	
Die einzelnen Maßnahmen nach Aufwand und Nutzen zu bewerten.				1			
Ferner über den Tellerrand zu schauen und Synergien mit Nachbarabteilungen zu erkennen.			1				
Zusammentragen abteilungsübergreifender Informationen; Schaffung eines Gesamtüberblicks.			1				
Diskussion der Instrumente in großer Runde; Diskussion mit MARA Team (unparteiische Anmerkungen und neue Sichtweisen); sehr gute wissenschaftliche und methodische Grundlage.	1						
Hoffentlich transparente Ergebnisse.					1		
Objektive Auswertung teilweise subjektiver Eingaben.				1			
Ausschlussverfahren, Prioritätsbewertung (Punktebewertung), Zwang zur Festlegung (Wertigkeiten festlegen).				1			
Umfassend, nachvollziehbar, breit.					1		
Kreativ.							

Annex 7: Qualitative Survey Results – Strengths of Socio-technical Decision Analysis (cont.)

Criteria	Interactive and dialogue-oriented information exchange	High participation and involvement in general	Effective transfer of data and opinions	Systematic, structured analysis	More transparent and comprehensible decision process	Strategic focus (beyond day-to-day business)	Flexibility
Statements:							
Vergleichbarkeit verschiedener Projekte.					1		
Verbessertes Rating hinsichtlich des Kosten-Nutzen-Verhältnisses zwischen den einzelnen GA-Förderfeldern.				1			
Die Bewertung ist kein starres System, es kann den aktuellen bzw. sich ändernden Bedingungen angepasst werden.							1
Eine breite Einbeziehung im Vorfeld qualifiziert die Entscheidungsanalyse sehr gut.		1					
Für Außenstehende bzw. für die jeweilige Leitung ist das Modell übersichtlich und schnell verständlich.					1		
Transparenz.					1		
Informationsausstausch und Dialogorientierung.	1						
Die eigene Entscheidungsanalyse reflektieren und neue Entscheidungsstrategien vorgestellt zu bekommen.							
Festlegung von objektiven Kriterien.				1			
Die Entscheidung kann transparent und nachvollziehbar begründet werden.					1		
Entscheidungen nachvollziehbar und transparent, für alle Projekte gelten die gleichen Kriterien.					1		
Vorhergehende Diskussion.	1						
Zwang, die Analyse strukturiert durchzuführen.				1			
Neuverknüpfung von Details.							
Formulierung von Kriterien und Abstimmung über deren Gewicht.				1			
Einbeziehung von mehr Mitarbeitern.		1					
Objektivierung der subjektiven Bewertung.				1			
Systematisierung von Fakten und Ideen.				1			
Kommunikation, Interaktion, breites Spektrum von TN, Diskussion verschiedener Meinungen und Konsensbildung.	1						
Durch Diskussion vor der Analyse im Rahmen der Entscheidungskonferenz zusätzliche Aspekte kennen gelernt.	1						
Austauschkenntnisstand und Vorstellung eines größeren Mitarbeiterkreises, größere Sicherheit für die zutreffenden Entscheidungen.		1					
Daten- und Informationsaustausch.			1				
Zwang, Zeit zu nehmen für Problemstellung, "extern" andere Sichtweise auf Problemstellung.							
Die "Wertesysteme" und Denkmuster von Kollegen, die ansonsten nur am Rande in Entscheidungen eingebunden sind, wurden deutlich.	1						

Annex 7: Qualitative Survey Results – Strengths of Socio-technical Decision Analysis (cont.)

Criteria	Interactive and dialogue-oriented information exchange	High participation and involvement in general	Effective transfer of data and opinions	Systematic, structured analysis	More transparent and comprehensible decision process	Strategic focus (beyond day-to-day business)	Flexibility
Statements:							
Diskussion mit allen relevanten Personen zum Thema GaN.	1						
Einscheidungen werden transparenter.					1		
Es gibt einen Diskussionsleitfaden für „Grundsatzdiskusionen" und damit einen „Zwang", derartige Diskussionen zu führen, da die Bewertung am Ende im Konsens getroffen werden muss.	1						
Die Diskussion.	1						
Diskussion zwischen den Beteiligten angeregt (erzwungen).	1						
Intensive Einbindung vieler Personen in den Prozess.		1					
Hohe Transparenz.					1		
Intensive Auseinandersetzung mit den Gründen für die Entscheidung, dadurch hohe Bereitschaft der beteiligten Personen, die Ergebnisse zu akzeptieren.	1						
Die Entscheidungsanalyse fordert Fragestellungen heraus, die sehr konkret zu beantworten sind. Wenn ein Auswerteprogramm vorliegt, kann der Einfluss verschiedener Bewertungskriterien ermittelt werden.				1			
Die Diskussionen sind konstruktiv und sind sowohl für das Finden als auch für das spätere Tragen der Entscheidungen nützlich.	1						
Sehr interaktive Analyse, guter Informationsaustausch.			1				
Strukturierung des internen Diskussionsprozesses durch Aufspaltung in unterschiedliche Kriterien.				1			
Interaktiv, dialogorientiert.	1						
Transparent.					1		
Der Diskussionsprozess wird auf breiter Front angeregt.	1						
Strategische Diskussion durch Management/Auftraggeber hinsichtlich Wahl und Gewichtung von Kriterien						1	
Total	18	5	5	15	12	3	1
Overall	63						

Annex 8: Qualitative Survey Results – Weaknesses of Socio-technical Decision Analysis

Criteria	Pseudo-scientific preciseness; highly subjective elements	High process complexities	Highly time consuming	Data assessment difficulties	Danger of 'manipulating' the system	Case-specific, content related issues	Insufficient content contribution of consultants
Statements:							
Objektivierung nicht immer gegeben, viele subjektive Einschätzungen.	1						
Inhaltsfreies Arbeiten möglich (seits Consultants).							1
Die unterschiedlichen Reichweiten von Maßnahmen konnten nur unzureichend berücksichtigt werden. Die Grundsatzthemen, die für alle gelten, schnitten gut ab, bleiben aber grundsätzlich.				1			
Pseudo-Genauigkeit.	1						
Übung mit dem System ist erforderlich, hohe Komplexität im Vergleich zum Ergebnis.		1					
Hinterfragung des inhaltlichen Inputs seitens der Consultens, Mut zur Kritik.							1
Wie groß ist die Reichweite von Maßnahmen.						1	
Vorhersehbarkeit durch Reichweite ohne Kosten. Fehlende Bestandteile Saved-Cost, dennoch Auswertung.						1	
Festlegen der Ausgangsbedingungen essentiell, Nachbessern schwierig. Modell immer nur so gut, wie der Input, der seitens der Teilnehmer gebracht wird.				1			
"Scheinwahrheiten" - Modell nur so gut wie sein Input.	1						
Bei vielen Maßnahmen, Zielgruppen und Kriterien z.T. zu komplex und Bewertung schwierig – vor allem Vergleichbarkeit der Relationen zwischen sehr verschiedenen Maßnahmen schwierig.				1			
Meine Erfahrung war, dass Verantwortliche für Einzelzielgruppen in der Lage waren, ihre Interessen (durch Mehrheit) durch die Wahl der Gewichtungen von Kriterien stark einzubringen und dies dann aus Zeitgründen nicht mehr ausdiskutiert bzw. hinterfragt wurde.					1		
Inhaltsfreies Arbeiten der Consultants.							1
Objektivierung nicht immer gegeben.	1						
Bessere Definition und Skalierung der Nutzenfaktoren.				1			
Sehe grundsätzlich keine, sofern sie nicht normativ, sondern den Entscheidungsprozess unterstützend eingesetzt wird. Das ist eher eine Frage der Akzeptanz auf Mitarbeiterebene (unterschiedliche fachlich-intellektuelle Voraussetzungen).							
Die Ergebnisse der Entscheidungsanalyse stehen häufig im Widerspruch zur subjektiven Erwartung. Daher werden die Ergebnisse nur zur Entscheidungshilfe von der Leitungsebene herangezogen und nicht konsequenter angewendet bzw. weiter qualifiziert.							
Fokussierung auf Kosten-Nutzen Faktor, zu starke "Robustheit" des Models - wenig Auswirkungen von Gewichtungsänderungen der Kriterien im Vergleich zur Präsenz des Kostenfaktors.							

Annex 8: Qualitative Survey Results – Weaknesses of Socio-technical Decision Analysis (cont.)

Criteria	Pseudo-scientific preciseness; highly subjective elements	High process complexities	Highly time consuming	Data assessment difficulties	Danger of 'manipulating' the system	Case-specific, content related issues	Insufficient content contribution of consultants
Statements:							
Kann erst der Praxisverlauf zeigen.							
Starre Anwendung kann zu "Ungerechtigkeiten" führen.							
Politische Einflussnahme bleibt unberücksichtigt. Starre Anwendung kann zu „Ungerechtigkeiten" führen, da spezifische Sachverhalte des einzelnen Projektes unberücksichtigt bleiben.							
Zu zeitaufwendig.			1				
Kriterien der Bewertung sind zu unscharf und fordern Bauchentscheidungen heraus, bestimmte Randbedingungen sind schwer zu berücksichtigen (kein MARA Problem).				1			
Zeitaufwand ist relativ hoch.			1				
Sehr erklärungsbedürftige Bewertungskriterien, die nicht zwingend konsistent waren, z. T. kompliziert verklausuliert.				1			
Viele Mannstunden, nicht alle Beteiligten verfügen über ausreichende Kenntnisse über wichtige Faktoren (Förderpolitik, Partner).			1				
Langwierigkeit, lähmende Wiederholungsdiskussionen von bereits vorher ausführlich besprochenen Sachverhalten.			1				
Teilweise zu langwierige Diskussion über unerhebliche Sachverhalte.			1				
Bewertungen werden gefällt, ohne die „Konsequenzen" zu kennen – dieses Problem sollte sich meines Erachtens von allein lösen, wenn das Verfahren mehrfach und regelmässig (z. B. alle 2 Jahre) genutzt wird.							
Fehlende Quantifizierbarkeit und Reproduzierbarkeit bei der Ermittlung der Wichtungen. Auf dieser Basis kann eine mathematische Wichtung der Themenkreise nicht funktionieren. Die EXCEL-Auswertung nach nicht klar offen gelegten Verfahren führt zu fehlerhaf	1						
Die Berücksichtigung des Risikos hat zur Konfusion geführt, das geht so nicht. Die Methode darf nicht einfach online modifiziert werden, wenn der Institutsleiter ein bestimmtes Ergebnis sehen möchte.					1		

Annex 8: Qualitative Survey Results – Weaknesses of Socio-technical Decision Analysis (cont.)

Criteria	Pseudo-scientific preciseness; highly subjective elements	High process complexities	Highly time consuming	Data assessment difficulties	Danger of 'manipulating' the system	Case-specific, content related issues	Insufficient content contribution of consultants
Statements:							
Modell berücksichtigt nicht möglich Kopplungen zwischen Themenfelder, wirkt eher linear, berücksichtigt komplexe Prozesse wenig.				1			
Mathematik hinter den Entscheidungen nicht durchschaubar - „black-box".		1					
Hoher Zeitaufwand, großer Strukturierungs- und Planungsbedarf.			1				
Die Bewertungen einschließlich der „quantitativen" Skala von 0...100 sind relativ intuitiv.	1						
In der zweiten MARA Analyse wurden einige Themen bewertet (z. B. Materials Analytics, Process Technology increment), die vorwiegend Service Leistungen für andere Projekte darstellen. Entweder sollte man solche Projekte vorher ausklammern oder die Vernetzun						1	
Scoring ist durchaus problematisch und meiner Meinung nach durch die Beschränkung auf die einzelnen Topics mitunter wesentlich ungenauer als "Entscheidung aus dem Bauch".	1						
Evtl. würde eine zweite Scoring-Runde helfen, nachdem die vorläufigen Analyseergebnisse und Schächen der Analyse bekannt sind.							
Ein gewisses Problem scheint die Bevorzugung von relativ kleinen Projekten su zein, die offensichtlich immer recht effizient ausfallen. In der Realität ist das jedoch oft genau invers.						1	
Es wird teilweise eine Objektivität suggeriert, die nicht gegeben ist, da die Wertung in den einzelnen Aspekten sehr subjektiv gefärbt ist.	1						
Sehr zeitaufwending.			1				
Beinhaltet immer noch sehr viele intuitiv festgelegte Parameter.	1						
Die MARA-Methode hat bei der Anwendung im Bereich Forschung einige grundlegende Schwächen, die ihre Ergebnisse fragwürdig machen (fehlende Genaukeit bei der quantitativen Erfassung der Kriterien führt zu großen Unsicherheiten im Ergebnis und verzerrt das Ergebnis.	1						
Total	10	3	8	9	3	4	3
Overall	48						

Annex 9: Qualitative Survey Results – Improvement Possibilities

Criteria	Better measurement: More careful weighting and scoring	Use comparable options	Use more time for analysis	Design shorter and more precise process	Higher process transparency	Increase degree of involvement	More applications have to reveal further improvement possibilities
Statements:							
Hinterfragen der Informationen.	1						
Die Maßnahmen, die in die Bewertung einfließen, sollten vom Wirkungskreis grob vergleichbar sein. Die Anzahl der Maßnahmen in einer Säule sollte nicht automatisch dazu führen, dass sie sich die Bedeutung für das Projektziel teilen müssen.		1					
Gewichtung der einzelnen Türme der Skyline hat zu hohen Einfluss auf das relative Gewicht der einzelnen Maßnahmen.	1						
Höhere Transparenz - was passiert als nächstes - Prozess im vorab erklären (verständlich, ohne Fremdwörter und auf deutsch).					1		
Mehr Zeit, fehlende Bestandteile nicht zulassen.			1				
Ausreichend Zeit für die eindeutige Festlegung der Ausgangsbedingungen und der Bewertungskriterien.			1				
Vergleichbarkeit der alternativen Maßnahmen sicherzustellen. Alle Teilnehmer müssen ähnliche Voraussetzungen für die Einschätzung der Maßnahmen auf den Kriterien ansetzen (z.B. bei Kostenberechnung oder Anzahl der Mitarbeiter, die durch Maßnahme erreicht		1					
Bessere Erläuterung warum was wie gegeneinander gewichtet wird.					1		
Strategische Diskussion durch Management/Auftraggeber hinsichtlich Wahl und Gewichtung von Kriterien (z. B. Imagefaktor: 50 und/oder 80 %).	1						
Hinterfragen der Informationen.	1						
Klarere Definitionen, um ein einheitliches Verständnis bei allen Teilnehmern zu gewährleisten.					1		
Mehr Transparenz bei der Bewertung der jeweiligen Maßnahmen (ich weiß bspw. nicht, wie meine Kollegen ihre Maßnahmen kostenkalkuliert haben.					1		
Bislang haben wir (noch sehr erkläungsbedürftigen) Prototypen. Mit zunehmender Implementierung steigt die Anschaulichkeit (Fallbeispiele) und damit auch die Akzeptanz auf allen Organisationsebenen.							1
Indem weitgehend alle Experten des jeweiligen Prozesses einbezogen werden. Damit wird die Akzeptanz der Entscheidungsanalyse erhöht.						1	
Längere Indikatorensuche.			1				
z.Z. keine Aussage möglich, da sich die Methode in der Praxis weiterentwickeln muss.							1
Kann erst der Praxisverlauf zeigen.							1

Annex 9: Qualitative Survey Results – Improvement Possibilities (cont.)

Criteria	Better measurement: More careful weighting and scoring	Use comparable options	Use more time for analysis	Design shorter and more precise process	Higher process transparency	Increase degree of involvement	More applications have to reveal further improvement possibilities
Statements:							
Wird sich in der Anwendung zeigen.							1
Kürzer, prägnanter.				1			
Von der Analyse sollte eine Studie, die im wesentlichen Faktoren enthält, erstellt werden, einschließlich Marktanalyse. Auf dieser Basis können die TN die Diskussion effektiver führen.			1				
Simplere Formulierung.					1		
Die auf die FBH angepasste Methodik müsste erst mal bei weiteren Fragestellungen angewendet werden, bevor man über Verbesserung sprechen kann.							1
Einführung kürzen, Erklärung (Scoring) an einem kongreten Beispiel (wurde ja auch teilweise gemacht).				1			
Kriterien messbar machen. Zumindest klar beschriebene quantifizierte Einteilungen von intuitiv zu ermittelnden Größen definieren, dabei max. 5 Bewertungsstufen statt der Prozentskala verwenden. Die Zwischenebene (Gruppierung) entfernen, die Themen in nur	1						
Transparenz der Auswertung, Rück- und Mitkopplung zwischen Effekten.					1		
Diskussionsbasis muss inhaltlich besser sein. Es sind relativ wenig verlässliche Daten zur Marktanalyse und auch wenig Daten zur Wissenschaftsprognose mit herangezogen worden (trifft in unserem Fall insbesondere für die zweite P	1						
Entscheidunganalyse sollte mehr iterativ erfolgen, da das Scoring vor allem beispielweise für kleine Projekte immer problematisch ist und relevante Scores eigentlich erst bei Kenntnis des gesamten Bildes sinnvoll abgegeben werden können. Siehe auch Punkt 1.	1						
Bessere Vermittlung der Kriterien für die Zuordnung von Gewichten, Einbeziehung von einer größeren Zahl von Mitarbeitern mit der Möglichkeit, keine Wertung für Projekt vorzunehmen, die man nicht ausreichend kennt.						1	
Konsistenzchecks verkürzen.				1			
Total	7	2	4	3	6	2	5
Overall	**29**						

Annex 10: Alignment Values – MARA Case Deutsche Bahn Demographic Change

#	Option	Ex-ante difference to DC (DC - Ex-ante)	Ex-post difference to DC (DC - Ex-post)	Alignment Value (Dbefore - Dafter)
1	B11: Demografische Arbeitszeit	13.500	23.250	-9.750
2	B15: Mehr Urlaub bei Kind	21.000	4.000	17.000
3	B1: Langzeitkonto	41.000	37.750	3.250
4	B10: Altersgerechte Einsatzplangestaltung	13.000	11.750	1.250
5	B12: Gesetzliche Altersteilzeit	30.500	18.250	12.250
6	B13: Variante LzK	6.000	4.500	1.500
7	B14: Qualifizierungstarifvertrag	1.500	4.000	-2.500
8	B16: Vertrauensarbeitszeit	22.500	0.000	22.500
9	B3: Unternehmensinterne Altersteilzeit	41.000	37.000	4.000
10	B4: Zeit statt Geld	35.500	9.000	26.500
11	B5: Urlaubsstaffelung	8.250	16.750	-8.500
12	B9: Individualisierung der Einsatzplangestaltung	7.000	3.500	3.500
13	H1: Gesund und Aktiv	34.167	39.667	-5.500
14	H10: Gesundheitsbonus	23.333	12.833	10.500
15	H13: Suchtprävention	23.333	7.833	15.500
16	H14: Nichtraucherschutz und Raucherentwöhnung	14.000	12.833	1.167
17	H15: Betriebssport	23.000	21.667	1.333
18	H17: Gesundheitstage	11.000	17.333	-6.333
19	H18: Gesundheitswochenenden in den Alpen	16.833	10.500	6.333
20	H19: Gesundheitskampagnen mit den 4 Stars und DB GesundheitsService	10.833	16.500	-5.667
21	H20: DB Gastronomie	27.333	22.833	4.500
22	H21: PC-gestützte Gesundheitsberatung Gesund & Fit	2.333	0.167	2.167
23	H22: Forschungsprojekt zur Belastungsanalyse	8.167	16.333	-8.167
24	H3: Selbst Coaching Instandhalter/Rangierer	38.500	37.500	1.000
25	H3i: Selbst Coaching Maintenance	8.500	12.250	-3.750
26	H4: RFU Gesundheit	7.500	9.333	-1.833
27	H5: PTBS-Prävention	23.667	17.000	6.667
28	Q1: Umqualifizierung vom Schlosser zum Service-Techniker	32.250	25.250	7.000
29	Q10/Q23/Q26: Kompetenz-management (Instand...)	10.750	0.500	10.250
30	Q13: Einführung einer Q-card 50plus	19.750	26.750	-7.000
31	Q14: Zukunftswerkstätten zur Förderung des Mentalitätswandels	8.000	7.750	0.250
32	Q15: Online Möglichkeit zur persönlichen Standortbestimmung für Mitarbeiter	30.000	21.750	8.250
33	Q16: Durchlässigkeit der Bildungswege gewährleisten	19.250	14.500	4.750
34	Q17: Instrumente Know-how-Transfer	30.000	24.750	5.250
35	Q18: Patensystem bei Nachfolgeregelung	11.500	16.500	-5.000
36	Q19: Lernforen	11.500	9.750	1.750
37	Q2/Q6/Q22: Beschreibung von Entwicklungswegen für Schlüsselfunktionen zugänglich für alle Mitarbeiter und Führungskräfte	26.250	4.750	21.500
38	Q3/Q8: Lebenslanges Lernen beginnt in der Ausbildung – Geschäftsfeld übergreifender Einsatz von Auszubildenden während der Ausbildung	13.750	15.500	-1.750
39	Q4: Projekt ISA (Anrechnung beruflicher Kompetenzen auf ein Hochschulstudium (Vom EBET zum Bachelor of Engineering)	16.750	21.000	-4.250
40	Q5: Mechatroniker	22.250	15.750	6.500
41	Q9: Internationalisierung v. Qualifizierung (Sprachkurse)	1.500	4.000	-2.500

Annex 11: Alignment Values – MARA Case Deutsche Bahn Recruiting Channels

#	Option	Ex-ante difference to DC (DC - Ex-ante)	Ex-post difference to DC (DC - Ex-post)	Alignment Value (Dbefore - Dafter)
1	E 1 A: "Visit DB Girls"	17.500	25.750	-8.250
2	E 10: Medium Fair A: "Regional Recruiting"	8.750	2.250	6.500
3	E 11 A: "Binding Program"	6.625	5.250	1.375
4	E 12 A: "Herbstkolloquium"	10.125	8.500	1.625
5	E 13 Z: "Kamingespräch"	5.667	7.333	-1.667
6	E 15 Z: "Recruiting Party that involves Sports Events"	34.300	31.300	3.000
7	E 6 Z: "Recruiting Day"	8.750	11.375	-2.625
8	E 7 Z: "Visit DB selected"	8.000	10.500	-2.500
9	E 8 A: "Excursions"	7.000	7.875	-0.875
10	E 9 A: "Workshops"	10.875	1.500	9.375
11	E2 A: "Seminars"	0.000	4.375	-4.375
12	E3 Z: "DB Youth Party"	15.625	11.000	4.625
13	E4 Z: "Flagshipstore"	28.250	9.875	18.375
14	E5 Z: "DB Azubi Train"	17.500	16.750	0.750
15	K 10 Z: "Stud. hires Stud."	19.333	8.667	10.667
16	K 11 Z: "Selective Fairs"	4.750	2.250	2.500
17	K 12: "Large Fair A: Nationwide Fairs"	7.625	12.250	-4.625
18	K 13: "Medium Fair A: Campus Fairs"	18.875	25.625	-6.750
19	K 14: "Small Fair A: Professional Recruiting Event"	23.000	12.667	10.333
20	K 15 A: "Bonus for DB Employees"	4.250	21.625	-17.375
21	K 16 Z: "Sponsorships"	10.900	16.000	-5.100
22	K 17 V: "Access Sourcing"	14.500	28.500	-14.000
23	K 2: "Small Fair A: Regional Recruiting"	11.667	9.833	1.833
24	K 4 A: "Cooperation Schools"	19.000	10.600	8.400
25	K 5 Z: "Cooperation Schools extended"	9.750	0.750	9.000
26	K 7 A: "Cooperation BA"	8.875	6.625	2.250
27	K 8 A: "Cooperation UA"	4.667	4.167	0.500
28	K 9 A: "Cooperat. Schools"	14.167	32.667	-18.500
29	K1: "Medium Fair A: Regional Fairs"	6.667	10.167	-3.500
30	M 1 A: "DB Internal Press"	12.750	9.875	2.875
31	M 10 A: "Online Offers"	7.833	12.167	-4.333
32	M 11 Z: "Posters in Trains"	8.500	19.625	-11.125
33	M 12 A: "Poster Campaign"	7.000	7.500	-0.500
34	M 13 A: "External Press"	3.000	0.250	2.750
35	M 14 A: "Newspaper Articles"	20.375	28.375	-8.000
36	M 16 A: "Online Advertisement"	0.700	3.700	-3.000
37	M 17 A: "Online Offers"	22.000	40.500	-18.500
38	M 18 V: "Direct Mailing 3rd party"	4.750	2.375	2.375

Annex 12: Alignment Values – MARA Case Deutsche Bahn Investment Prioritisation

#	Option	Ex-ante difference to DC (DC-Exante)	Ex-post difference to DC (DC-expost)	Alignment Value (Dbefore - Dafter)
1	C1: Kundeninformation „gelb à grün" (Lichtenberg Kat.2)	8.714	7.786	0.929
2	C2: Kundeninformation „gelb à grün" (6 Bahnhöfe Kat.3)	7.000	0.071	6.929
3	C3: Kundeninformation „rot à grün" (1 Bahnhof Kat.4)	8.286	5.143	3.143
4	C4: Kundeninformation „gelb à grün" (13 Bahnhöfe Kat.4)	17.071	11.143	5.929
5	C5: Kundeninformation „gelb à grün" (6 Bahnhöfe Kat.5)	24.643	24.286	0.357
6	C6: Kundeninformation „gelb à grün" (34 Bahnhöfe Kat.6)	17.929	13.429	4.500
7	C7: Kundeninformation „W-LAN 2" (3 Bahnhöfe Kat.1)	6.857	14.571	-7.714
8	C8: Kundeninformation „W-LAN 2" (10 Bahnhöfe Kat.2)	6.786	13.571	-6.786
9	C9: Kundeninformation „RIBaba" (13 Bahnhöfe Kat.1+2)	3.286	14.857	-11.571
10	C10: BKundeninformation „RIS" (Kat.1-6)	19.000	4.714	14.286
11	D1: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „gelb à grün" (Zoo Kat.2)	13.643	16.500	-2.857
12	D2: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „gelb à grün" (14 Bahnhöfe Kat.3)	13.214	10.714	2.500
13	D3: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „rot à grün" (5 Bahnhöfe Kat.4)	8.857	6.143	2.714
14	D4: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „gelb à grün" (116 Bahnhöfe Kat.4)	4.429	2.286	2.143
15	D5: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „rot à grün" (2 Bahnhöfe Kat.5)	19.643	24.786	-5.143
16	D6: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „gelb à grün" (48 Bahnhöfe Kat.5)	11.500	11.500	0.000
17	D7: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „rot à grün" (12 Bahnhöfe Kat.6)	18.357	21.857	-3.500
18	D8: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „gelb à grün" (173 Bahnhöfe Kat.6)	16.143	8.929	7.214
19	D9: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „3-S-Zentrale" (3 Bahnhöfe Kat.1)	19.500	6.786	12.714
20	D10: Erscheinungsbild / Sicherheit / Aufenthaltsqu. „Infotainment" (3Bahnhöfe Kat.1)	17.071	20.571	-3.500

Annex 13: Alignment Values – MARA Case SenWAF Infrastructure Funding Prioritisation

#	Option	Ex-ante difference to DC (DC-Exante)	Ex-post difference to DC (DC-expost)	Alignment Value (Dbefore - Dafter)
1	IMB1: Baufeld Ost – Gewerbeflächenerschliessung	21.000	20.250	0.750
2	IMB1: Gewerbegebiet Seestr. – Abräumung u Wiederherrichtung	5.667	4.333	1.333
3	IMB1: Leit- und Orientierungssystem	15.500	9.833	5.667
4	IMB2: Ausbau der Gartenfelder Straße von Saatwinkler Damm bis Tegeler Brücke	9.625	10.500	-0.875
5	IMB2: Ausbau des Eisenhutweges von Akeleiweg bis Stubenrauchstraße	15.875	13.625	2.250
6	IMB2: Neubau der Buchberger Str.	8.625	9.750	-1.125
7	IMB2: Wiederherstellung der Brommybrücke	15.750	6.750	9.000
8	IMB2: Neubau der Kastanienallee von Hauptstraße bis Friedrich-Engels- Str. in Berlin-Rosenthal	4.375	4.875	-0.500
9	IMB3: Erneuerung S.-Kanal im Gross-Berliner Damm	8.800	10.400	-1.600
10	IMB3: Erneuerung TWA im Gross-Berliner Damm 3.BA	8.000	9.200	-1.200
11	IMB3: Erneuerung zur Abwasserentsorgung im 2.BA im Wiesendamm	0.400	3.200	-2.800
12	IMB3: Erweiterung d. Regenentwässerungsanlagen, Bln.Mitte:Alexanderplatz der BWB	2.700	4.600	-1.900
13	IMB3: Erweiterung u. Erneuerung von Mischwasseranlagen, Bln.Mitte:Alexanderplatz der BWB	3.600	7.300	-3.700
14	IMB3: Regenentwässerung; Stark- u. Schwachstromanlagen Wista-Nord	9.750	10.250	-0.500
15	IMB4: Berliner Mauerweg	0.625	2.375	-1.750
16	IMB4: Herrichten des Geländes zw. Museumsinsel u. Hackeschen Markt (3.BA)	4.875	4.625	0.250
17	IMB4: Machbarkeitsstudie Fuß- und Radwegverb. über die Müggelspree	25.167	18.333	6.833
18	IMB4: Müggelparksanierung (Wege, Ufer, Stege); touristisches Wegeleitsystem	1.875	0.250	1.625
19	IMB5: Ausstattung Arbeits- und Kulturzentrum e.V.	7.625	7.250	0.375
20	IMB5: Ausstattung d OSZ Hauswirtschaft u Lebensmitteltechnik Emil- Fischer Schule/Reinickendorf	2.625	1.375	1.250
21	IMB5: Erhöhungsantrag zum Umbau der staatl. Balettschule	16.625	15.750	0.875
22	IMB5: Errichtung eines Ausbildungszentrums in Bln.-Adlershof; Sanierung u. Ausbau des Gebäudes 11.06, Gustav-Kirchhoff-Str. 1	2.875	1.875	1.000
23	IMB5: OSZ Chemie/Physik/Biologie / Beschaffung v Ausstattung im Bereich Physik/Physiktechnik	3.750	5.125	-1.375
24	IMB5: OSZ Handel II - Erweiterungsbau sowie Umbau und Modernisierung der Sporthalle	9.625	8.375	1.250
25	IMB5: OSZ Wirtschaft und Verwaltung – tech. Ausstattung	0.375	0.000	0.375
26	IMB6: Ausbau von Gewerbeeinheiten im Gewerbezentrum Plauener Straße	4.400	3.600	0.800
27	IMB6: Errichtung eines Kompetenzzentrum Verkehr	20.625	17.625	3.000
28	IMB6: ETF GSG Hof Helmholtzstr. (Torhaus 2)	9.900	9.300	0.600

Annex 14: Alignment Values – MARA Case FBH Appraisal of Research Directions

Option	Ex-ante difference to DC (DC-Exante)	Ex-post difference to DC (DC-expost)	Alignment Value (Dbefore - Dafter)
1	0.786	0.143	0.643
2	0.214	0.071	0.143
3	4.643	3.714	0.929
4	3.571	3.000	0.571
5	0.571	0.071	0.500
6	1.286	0.571	0.714
7	2.929	2.571	0.357
8	2.786	1.357	1.429
9	0.429	0.143	0.286
10	3.571	3.286	0.286
11	2.000	0.286	1.714

Annex 15: Alignment Values – MARA Case FBH Portfolio-based Analysis of Research Strategies

#	Option	Ex-ante difference to DC (DC-Exante)	Ex-post difference to DC (DC-expost)	Alignment Value (Dbefore - Dafter)
1	BT: Epitaxy, Epitaxie	11.8571	10.6429	1.2143
2	BT: Material analytics, Materialanalytik	3.5714	3.1429	0.4286
3	BT: Process technology, Prozesstechnologie	10.3571	9.9286	0.4286
4	ET: Components, Bauelemente	2.5625	4.3125	-1.7500
5	ET: GaN electronics for high-power switching	11.4375	10.7500	0.6875
6	ET: GaN Optoelectronics, GaN Optoelektronik	8.0000	8.7500	-0.7500
7	ET: Materials, Materialien	5.3750	5.1250	0.2500
8	ET: Processes, Prozesse	10.2500	9.8750	0.3750
9	ET: Terahertz, Terahertz	0.8750	0.1250	0.7500
10	MT: HBT-MXXXs	0.9375	1.6875	-0.7500
11	MT: High-Frequency Expertise, Hochfrequenz Expertise	2.1250	2.0625	0.0625
12	MT: Microwave GaN components, Mikrowellen GaN Komponenten	11.8750	12.9375	-1.0625
13	MT: Plasma Generation	1.0625	1.3125	-0.2500
14	OE: High beam quality LD, Diodenlaser hoher Strahlqualität	3.1429	3.7500	-0.6071
15	OE: High brilliant LD, Hochbrillante Diodenlaser	4.0000	2.8750	1.1250
16	OE: High power LD, Hochleistungsdiodenlaser	4.3750	5.3125	-0.9375
17	OE: Hybrid laser systems, Hybride Lasersysteme	7.6875	6.6875	1.0000
18	OE: Laser expertise, Laserexpertise	5.6875	6.2500	-0.5625
19	OE: Sensor systems, Sensorensysteme	8.4375	7.5000	0.9375